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Comparison of Various Types of Ball Bearings

Relation Between Over-all Width Tolerances and Radial Play Mathematically Demonstrated—Difference in Radial Play Before and After Mounting

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WITHIN a comparatively short time a great deal of attention has been paid to the general subject of ball bearings. Several national engineering societies have appointed committees to work together in an attempt to obtain better standardization. A list of acceptable tolerances has already been prepared covering all of the external dimensions of a ball bearing, namely, the outside diameter, the bore, and the over-all width. Manufacturers and users have accepted these tolerances and have thereby improved the position of ball bearings quite appreciably. In addition to the above standard tolerances, many users of ball bearings are specifying definite limits of radial play.

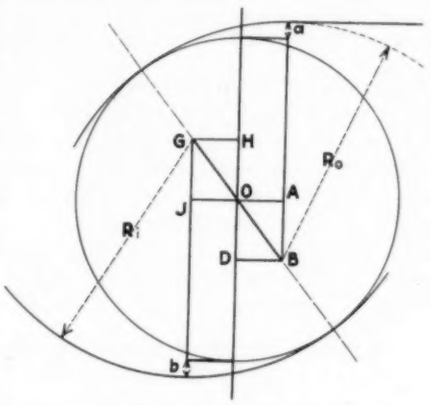


FIG. 2. PARTIAL SECTION OF CONE OR OPEN SIDE TYPE OF BEARING

From the remarks and mathematical proof further on in this article it will be seen that there is a definite relation between the over-all width tolerance and the radial play. To explain this more clearly it must be stated that the width tolerance is used in connection with the distance from one side of the outer ring to the opposite side of the inner ring. This is true only for the so-called open-side types of bearings. Fig. 1 shows the dimension on which the tolerance is used.

Proof of Relation Between Radial Play and Over-all Width Tolerances

It was stated above that there is a relation between radial play and over-all width tolerances. Before explaining the proof of this and determining a formula for the relationship let us define radial play. Radial play is the amount of shake or looseness between the inner and outer rings or raceways of a bearing in a direction at right-angles to the bore. In the diagram (Fig. 2) a partial cross-section of a cone or open-side type of bearing is shown. It is evident that as the radial play in this half of the bearing (the sum of the distances a and b) increases, the angle of contact also increases. Since points G and B are respectively the radii centers of the inner and outer races, if the angle increases there will be an increase in the axial distance between these centers. This axial distance is the sum of GH and DB. Any variation of this axial distance between centers results in a variation in the line-up of the two rings. This in turn results in a variation of the over-all width, due to the method of measuring this dimension as outlined above. In the ordinary type of radial bearing as shown in Fig. 3, this relative motion of the race centers is the end play. Thus we have a definite relationship, for any bearing, between the following three items, namely, the radial play, the end play, and the over-all width tolerance. It will be appreciated that an ambiguity results if a user specifies limits on more than one of these quantities at a time.

Development of Formula Showing the Relation of End Play to Radial Play

The formula giving the relation between end play and radial play is worked out below. This development is based on the specific conditions met in a cone type bearing. The translation of the result from one type to another is easily accomplished as will be explained.

In Fig. 2

$$(1) \qquad a = Ro - \frac{S}{2} - AB$$

$$(2) \qquad b = Ri - \frac{S}{2} - GJ$$

where,

Ro = outer ring race radius
Ri = inner ring race radius
S = ball diameter.

adding (1) and (2)

$$a + b = Ro + Ri - S - AB - GJ$$

$$\text{or, } AB + GJ = Ro + Ri - S - (a + b)$$

Let, $a + b = R = \frac{1}{2}$ the radial play.

$$(3) \quad \text{Then, } AB + GJ = Ro + Ri - S - R$$

$$(4) \quad \text{Also, } OB + OG = Ro - \frac{S}{2} + Ri - \frac{S}{2} = Ro + Ri - S$$

From the triangles, OGJ and OBD

$$(5) \quad (OB + OG)^2 = (AB + GJ)^2 + (DB + GH)^2$$

Let $DB + GH = E$ = axial displacement of race centers.

$\therefore$ From (5)

$$E = \sqrt{(OB + OG)^2 - (AB + GJ)^2}$$

substituting from (3) and (4)

$$E = \sqrt{(Ro + Ri - S)^2 - (Ro + Ri - S - R)^2}$$

Simplifying

$$E = \sqrt{2R(Ro + Ri - S) - R^2}$$

Since E is the axial displacement of race centers, in the above proof, we may obtain the end play of a radial bearing by multiplying E by two. This is necessary

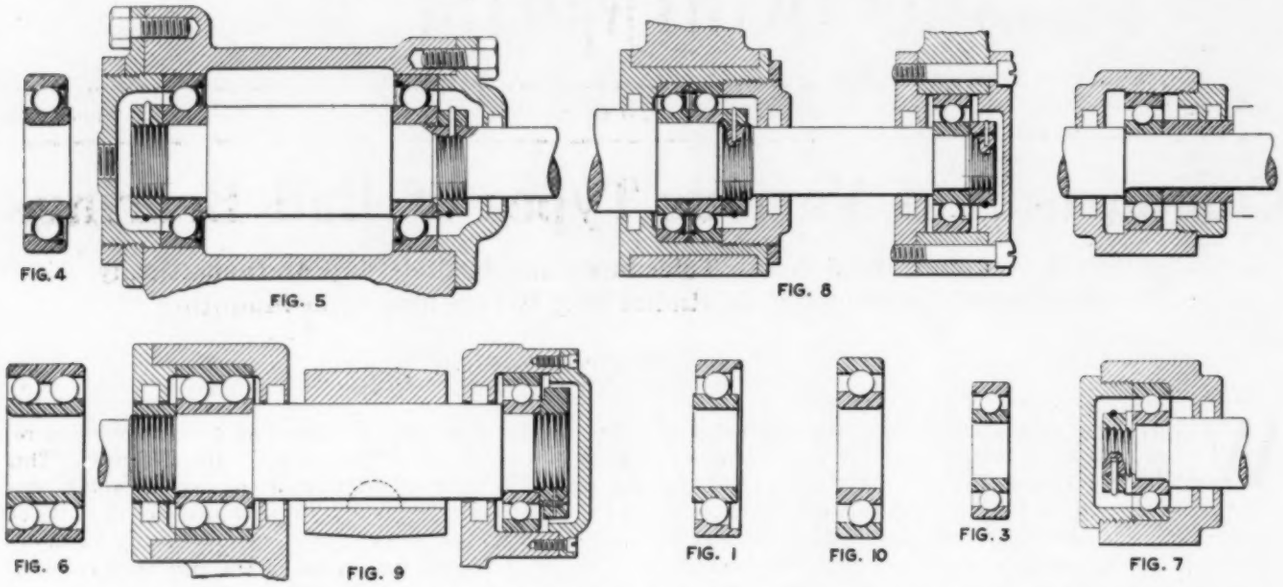


FIG. 1. WIDTH TOLERANCE ON OPEN SIDE TYPE OF BEARING. FIG. 3. ORDINARY TYPE OF RADIAL BEARING. FIG. 4. SINGLE ROW ANGULAR CONTACT TYPE OF BEARING. FIG. 5. ADJUSTABLE MOUNTING FOR BEARING SHOWN IN FIG. 4. FIG. 6. DOUBLE-ROW ANGULAR CONTACT TYPE OF BEARING. FIG. 7. USUAL METHOD OF MOUNTING RADIAL TYPE OF BEARING. FIG. 8. SAME CONSTRUCTION AS SHOWN IN FIG. 7, BUT USING THREE BEARINGS. FIG. 9. A SIMILAR MOUNTING TO THAT SHOWN IN FIG. 8, BUT HAVING LESS BULK. FIG. 10. THREE POINT CONTACT TYPE OF BEARING

because both the inner and the outer rings may be displaced to either side of the ball centers. Since R was used to represent only one-half of the radial play, care must be taken in the use of this factor, also.

To clarify the above let us work out a specific example. Consider a single row radial ball bearing having a measurable radial play of 0.002 in., a ball diameter of 0.375 in. ($\frac{3}{8}$-in.), an outer ring race radius of 0.217 in., and an inner ring race radius of 0.203 in.

Let us determine the end play from the above formula:

$$E = \sqrt{2R(Ro + Ri - S) - R^2}$$

from above.

$$Ro = 0.217$$
$$Ri = 0.203$$
$$S = 0.375$$
$$R = 0.002 \div 2 = 0.001$$

then,

$$E = \sqrt{2 \times 0.001\ (0.217 + 0.203 - 0.375) - (0.001)^2}$$
$$= \sqrt{0.002\ (0.045) - 0.000,001}$$
$$= \sqrt{0.000,090 - 0.000,001}$$
$$= \sqrt{0.000,089}$$
$$= 0.0094$$

Since E is only one-half of the total end play we have as a final result, twice 0.0094 in. or 0.0188 in.

The Effect of the Above on the User and the Manufacturer

It is apparent that if it is desirable to keep the end play down to small limits the radial play must be very small indeed. However, as pointed out in a recent article by one of the authors, the effect of too small an amount of radial play is a decided shortening in the life of the bearing. It is very necessary as a result of these facts that a user be very familiar with the subject before he attempts to specify either radial or end play. He must realize, for example, that there is a considerable expansion of the inner ring when it is forced over a shaft. This naturally reduces the radial play and under extreme conditions may cramp the bearing. To state it differently, the radial play of a bearing unmounted is entirely a different matter from the play in the same bearing after mounting. It is a very safe idea to get the recommendations of the bearing manufacturer before specifying limits for any but the external dimensions of a bearing.

Various Types of Bearings; The Combined Capacity Type

End play, which has been demonstrated, is also attended by radial play, and is in some types of bearings deliberately built in. In other types it is a defect. For instance, the so-called combined capacity type of bearings owe their ability to carry both thrust and radial loads to an angularity of ball contact with the grooves or races of the surrounding rings. This type of bearing appears, in cross-section, like the radial type shown in Fig. 3.

Single Row Angular Contact Type

A single row angular contact type of bearing is shown in Fig. 4. Here, as shown, the ball contact is not radial but at an angle with the axis of the shaft. This bearing requires an adjustable mounting as shown in Fig. 5, and requires considerable initial load to maintain the balls in proper contact with their races. This load, however, does not add to the load applied to the bearings due to the service requirements. In addition to this feature the ultimate load is carried by a majority of the balls instead of by only a few. This is made clear when we consider a radial type of bearing under purely radial load. As a maximum only one-half of the balls can be under load at the same time. Now consider a thrust bearing of the ordinary type under a purely thrust load. Here all of the balls are under load and each is taking its share. The angular contact type is virtually a direct combination of these two and, conse-

quently, the number of balls under load is somewhere in between one-half and all of them. For certain combinations of load this type is superior.

It may be stated, however, that conditions which demand such a bearing are seldom met. While it is well known that the greater the angle of contact the greater the thrust load capacity, still all so-called radial bearings instantly become angular contact upon the application of thrust and to such a degree as to be able to withstand the load satisfactorily. In connection with this, let us state a fact which is little realized, that a given radial bearing will last longer under a combination of thrust and radial load than under the same amount of radial load only.

The angular contact type is the only satisfactory bearing for use where dirt and corruption are present, since, due to its adjustable feature, it is possible to compensate for wear. Made of proper materials and well designed, it is an easily recognized big brother to the cup and cone bearing of earlier days. The perfect bearing of this type would be designed with the ball contact angle a resultant of the combined radial and thrust loads which would mean simply variations of radial or end play. As a final description of this type, let us say that it is simply a sloppy radial bearing.

Where only one bearing can be applied it is essential that either a double row angular contact or a single or double row radial type of bearing be used. The sloppy construction of the single row angular contact type would cause both end play and vibration.

The double row angular contact type, shown in Fig. 6, possesses all of the advantages of the single row series in that it can carry both radial and thrust loads. It also has the added advantage of being a unit and being capable of taking thrust from either side. It can be locked in position without danger of overload from initial adjustment. It has no slop or radial and end play and in such places where there are changes in temperature which would cause shaft expansion and contraction, due to these conditions, it stands alone.

Where smooth running with a minimum of friction and an absence of end play are prime requisites, as in machine tool and grinding spindles or other machine parts, these bearings, due to the fact that the initial load from adjustment, as in the case of the single row angular-contact type, is unnecessary, render much more efficient service.

This brings us to the discussion of the well-known radial type of bearing which we have referred to several times (Fig. 3). The usual method of mounting is illustrated in Fig. 7. Here if radial play is present, after mounting, it is immediately noticeable in spindle vibration. The standard limits of radial play to which most manufacturers hold their product minimizes this trouble. The particular mounting shown is the only one that satisfies the requirements of good practice. It will be noticed that one bearing is locked both ways to prevent end motion of the spindle, and that the other is free to float in its housing. This allows very nicely for any increase in shaft or housing length and prevents any possible cramping of either bearing. This construction is sometimes used with the single row angular contact type by using three bearings. A mounting of this sort is shown in Fig. 8. This is a bulkier arrangement than a similar mounting shown in Fig. 9. Here a unit double row angular contact type is used to answer the same purpose. The type discussed above (see Fig. 8) requires a special pair of bearings or else it is liable to destruction by too generous an adjustment, since the standard type has an outer ring narrower than the inner.

It may appear to some readers of this article that the three point contact type of bearing, shown in Fig. 10, is the preferred form. There are perhaps two good reasons for at first forming this opinion. First, it seems as if both radial and end play are practically eliminated, providing conditions are at all ideal. Second, there is a chance for considerable angularity of contact as indicated by the dotted line.

The end play, however, does exist, when we consider the inner ring, as does its accompanying radial play. If it did not exist to a degree great enough to allow the angularity of contact indicated, free or pure rolling motion would be hindered. On the other hand, if they (radial and end play) existed in too great an amount, pure rolling would again be lessened. From the above it will be seen that this nicety of fit is commercially impossible of achievement. This fact is demonstrated by the greater friction and shorter life of this type of bearing.

Is Superficial Training Satisfactory?

By W. K. Campbell

It is my personal observation that we are trying to make mechanics by other methods than the old basic principles as laid down by our forefathers, namely, the apprenticeship training.

A man is taken into our machine shops, and in many cases is taught how to run only one particular machine and then kept on that one machine indefinitely. To be sure he becomes a specialist on that machine, not because he is brainy, but in spite of himself. No wonder he is able to produce more than a man who might manipulate the same machine intermittently. After awhile the operator, from his association with his shopmates and due to environment and shop talk, conceives the idea that he is a machinist, leaves his job and seeks employment in another shop as a "machinist." He is engaged and his new foreman having learned his trade in the old-fashioned way, begins to wonder what manner of man he is if this new addition is a "machinist."

How different this is from our school system! First comes the primary grades (modern times precede this now with the kindergarten where they teach the letters and their sounds as well as their combination in words) then the grammer grades, the high school, then either the technical, academic school or college, and through all this time a general training and development of the mind to handle general subjects. Only after this training does one then attempt to specialize. True, after the first two years in technical school or college one may, to a certain degree, take up a line that will develop into a special line, but to complete a specialization they must do a great deal of post-graduate work, such as is done by our doctors, lawyers, etc., and if this method is essential in professional lines, why is it not just as essential in industrial lines?

Fortunate is that organization that has always adhered to the apprenticeship method, for they have developed a line of mechanics that will produce the goods, and no matter where they may roam they can not help but reflect credit on their Alma Mater.

I do not believe we can get along indefinitely on substitutes for fundamentals and I still think we must adhere to the thorough rather than the superficial training if we are to keep our place as the leader in the industrial world.

Another Method of Machining Connecting Rods

Unusual Methods and Fixtures—Facing Both Ends of a Boss at Once—Drilling Machine with Special Attachment—Boring Two Rods in One Operation

BY FRED H. COLVIN
Editor, *American Machinist*

MACHINING the connecting rods for the White motor involves the use of some interesting fixtures, and methods which are somewhat unusual. The rod and cap are forged in one piece, as can be seen at *A* in Fig. 2.

The first operation is the rough drilling of the holes in the substantial fixture shown, the ends of the rod being centered by forks operated by the handle *A*, Fig. 1. The strap *B* carries the adjusting screw *C* and the ring nut *D* adjusts the support for the small end of the rod so as to take care of the variations in the forging.

Next comes the rough facing of the bosses, this being done in the special fixture shown in Fig. 2. One of the rough bored rods is shown at *A*. The hook clamps *B* and *C* go over the rod and hold it in position. The stop *D* prevents the rod being fed down too far. The four rotary facing cutters are provided with pilots which enter the holes at each end and help to guide the cutters. These facing cutters are driven from the

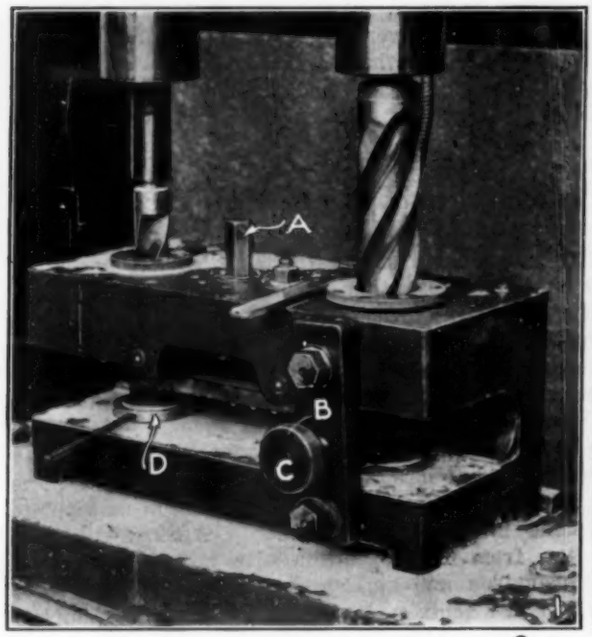


FIG. 1. ROUGH BORING BOLT HOLES.

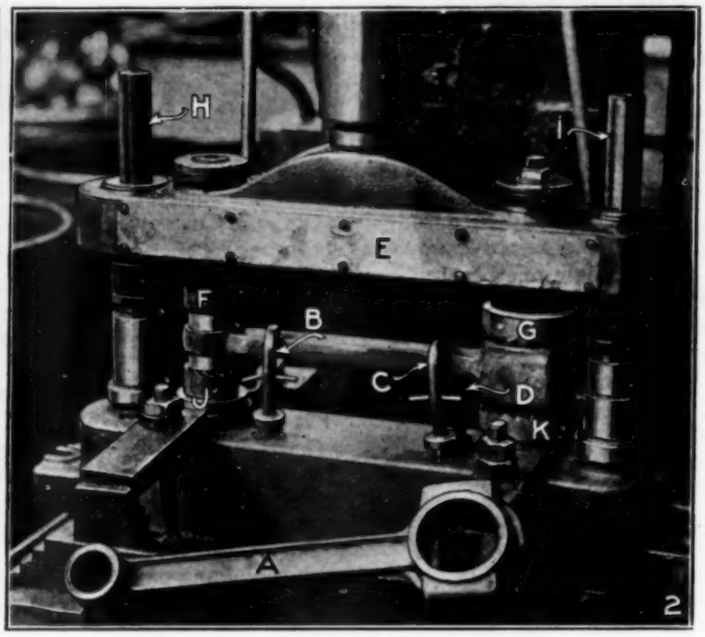


FIG. 2. FACING BOTH ENDS

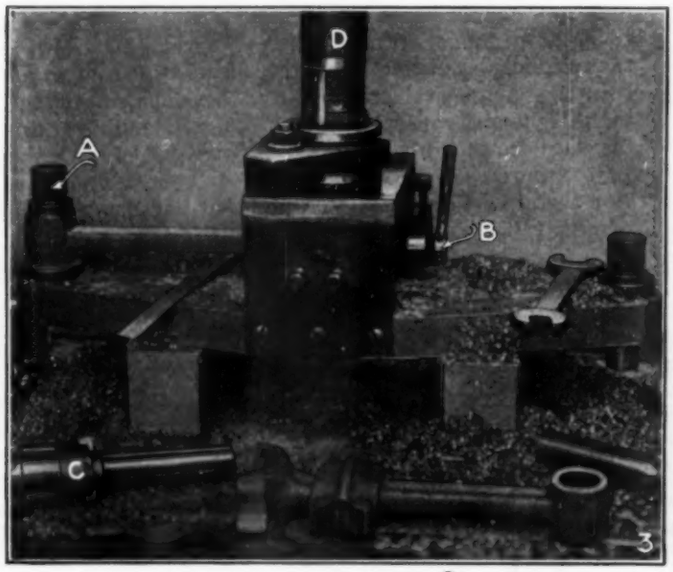


FIG. 3. FINISH BORING ROD AND CAP.

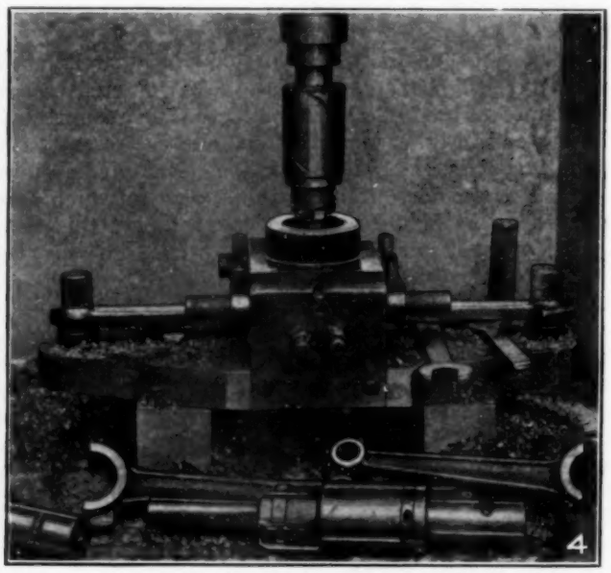


FIG. 4. FINISH BORING TWO RODS

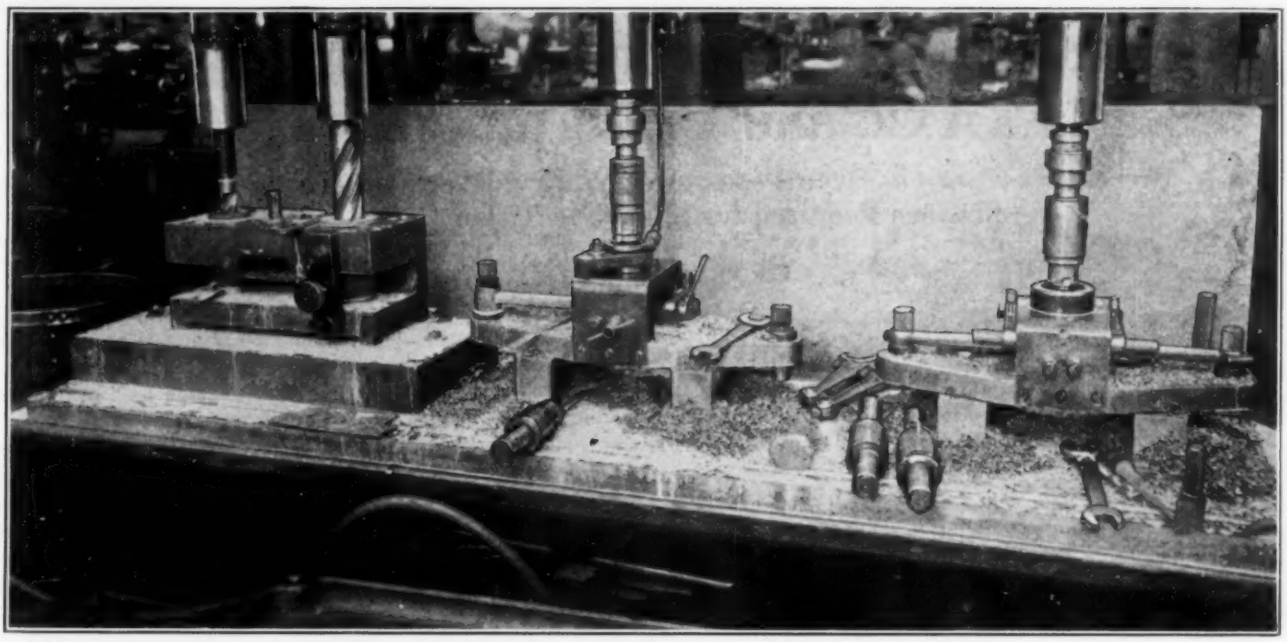


FIG. 5. THREE OPERATIONS ON ONE MACHINE

drilling machine spindle through gearing enclosed in the upper head *E*. The two upper cutters, *F* and *G*, are driven directly by this gearing while the lower cutters are driven by means of the splined shafts *A* and *I*, which in turn gear back to the lower facing cutters *J* and *K*. This device faces all four sides at one setting.

The caps are cut off with a thin saw or slitting cutter. Then the large ends of the rods are rebored in one of two ways, in the fixture shown in Fig. 3.

In the first case, the rod and cap are being bored together, the rod being located from the small hole by the pin *A*. The cap is held in position by a suitable clamp operated by the capstan-head screw at *B*. The rod and cap are then bored together using first a double ended cutter as at *C*, and then the inserted bladed reamer at *D*. These tools are both guided by suitable bushings in the lower part of the fixture.

Fig. 4 shows another method of using this same fixture. In this case, two connecting rods are bored instead of a rod and cap. The large ends of the rods are located by similar clamps as in the case of the bearing cap and the work proceeds in much the same way. It will be noted that in this case, the connecting rod is made to be split on the small end, while in the previous illustration it was a solid end rod. These rods are for different sizes of motors.

A sort of composite view of these operations is shown in Fig. 5, all being arranged on a four spindle drilling machine. The rough drilling is shown at the left, the rod and cap is being bored in the center and the two rods are being bored together at the right.

Draftsmen's Expectations

BY P. A. FREDERICKS

The accompanying chart shows in rather striking form the reasonable expectations of any young man who takes up drafting as a vocation.

The explanation is as follows: A boy of good qualifications, who is well adapted for drafting room work, should advance in ability according to the notes in the upper squares, though it will require hard work and outside study. If he does so advance, his worth (as represented by his salary should rise according to the curve which can be read against the index of percentages at the left.

Exceptional ability and exceptional hard work may show the higher or "mechanical engineer's curve." Lack of study will certainly show the lower or "lazy man's curve," and this in certain cases will also be the curve of the man totally unfitted. The reason for the lower salary of such a man will be that when he reaches for instance that tenth square in the year column, he will

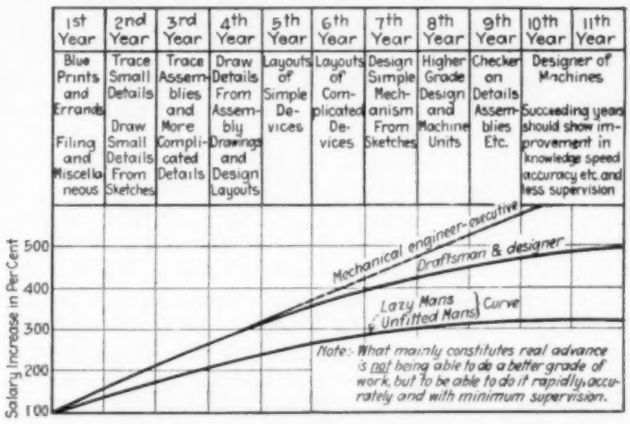

1st Year
2nd Year
3rd Year
4th Year
5th Year
6th Year
7th Year
8th Year
9th Year
10th Year
11th Year
Blue Prints and Errands Filing and Miscellaneous
Trace Small Details Draw Small Details From Sketches
Trace Assemblies and More Complicated Details
Draw Details From Assembly Drawings and Design Layouts
Layouts of Simple Devices
Layouts of Complicated Devices
Design Simple Mechanism From Sketches
Higher Grade Design and Machine Units
Checker on Details Assemblies Etc.
Designer of Machines Succeeding years should show improvement in knowledge speed accuracy etc. and less supervision
Salary Increase in Per Cent
100
200
300
400
500
Mechanical engineer-executive
Draftsman & designer
Lazy Mans & Unfitted Mans Curve
Note: What mainly constitutes real advance is not being able to do a better grade of work, but to be able to do it rapidly, accurately and with minimum supervision.

CHART SHOWING PROBABLE INCREASES IN PAY ACCORDING TO ABILITY AND SERVICE

be only in the fifth square in the ability curve and his salary will suffer accordingly.

To start in the lower left-hand corner a boy should: (1) Be adapted for drafting by inclination and ability. It is hard to state what qualifications are required with any exactness, but a reasonable aptitude in mathematics and a liking for mechanics must be included; (2) he should be reasonably quick and willing to be taught; (3) he must be ambitious and willing to study; (4) he should have some high school training, preferably have been graduated from high school, though it is not impossible to overcome a handicap in this direction if caused by anything other than dullness or stupidity in the branches of mathematics or similar subjects.

Methods Used in Locomotive Driving Wheel, Axle and Crankpin Work

Present Practice on Several Classes of Work in the Southern Pacific Shops —Allowance Required for Shrinking Tire on Driving Wheels

By FRANK A. STANLEY

AMONG other interesting features of the toolroom at the Sacramento shops of the Southern Pacific Co. are the gages for driving wheel centers and tires by which these parts are respectively turned and bored to give proper allowances for shrinking on the tires.

A set of such shop gages is shown in Fig. 1. These gages are regularly checked for accuracy by means of master gages, a set of which is shown in a heavy wooden case in Fig. 2. The master gages are made to the dimensions given below. The allowances for boring various sizes of tires for the desired shrinkages range as shown in the table for driving wheels from 45 to 84 in. nominal outside diameter.

pressure suffices to loosen the tire which is then slipped off.

The pressures used for forcing axles and crankpins into driving wheel hubs varies somewhat with different shops but probably a fair average is based upon not over eight tons' pressure per inch of diameter for axles forced into cast-iron wheels and ten tons' pressure per inch of diameter of fit where the axle is forced into cast-steel hubs. In some cases reported from important plants the pressures per inch of fit diameter have been considerably higher than the above, particularly with cast-steel hubs.

There are some interesting points connected with the pressing in and out of axles and crankpins. The

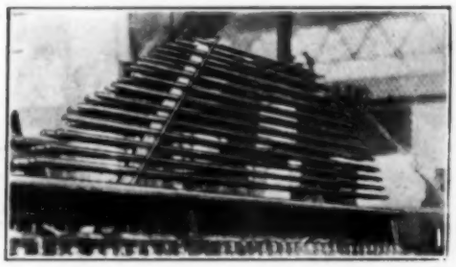


FIG. 1. SET OF ALLOWANCE GAGES FOR DRIVING WHEEL CENTERS AND TIRES. FIG. 2. MASTER GAGES

The general view, Fig. 3, illustrates the yard storage for driving wheel tires where each size is placed in a separate section of the storage space. In Fig. 4 a number of oil heater rings are shown hung up on racks for use on different sizes of tires. These use fuel oil and the method of application in the removing of tires from wheel centers is illustrated in Fig. 5. The pair of mounted wheels is picked up by the yard crane and placed upon a rigid support in the form of a fixed trestle; then the heater ring is brought into place around the tire and the oil jets from the perforated ring are ignited. A few minutes' application of the heat developed by the fine oil spray under air

character of the surface finish of the axle and the bore of the wheel has much to do with the total pressure required in forcing the two parts together, and the length of the fit is also a factor to be considered. The effect of the presence of the tire on the wheel is of interest in this connection. The shops referred to above remove tires before dismounting or mounting wheels. It has been found that a 10-in. axle which would press into the wheel hub under a total pressure of 120 tons (or ten tons per inch of fit diameter) when the tire was off, required 160 tons' pressure with the tire in place. In removing an axle of similar size it was found that 300 tons' pressure would not start

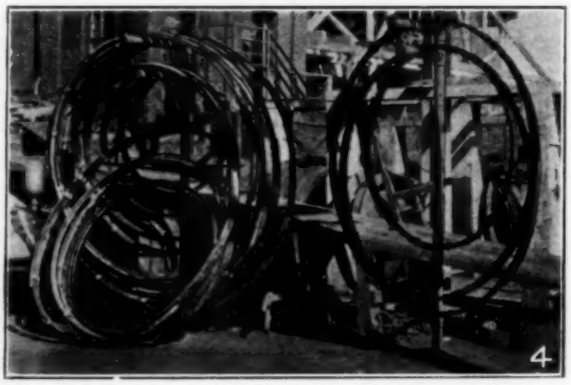


FIG. 3. AN ORDERLY YARD STORAGE SYSTEM FOR DRIVING WHEEL TIRES. FIG. 4. OIL HEATER RINGS FOR VARIOUS SIZES OF TIRES

FIG. 5. METHOD OF USING OIL HEATER RINGS FOR REMOVING TIRES

the axle with the tire in place. Similarly with crankpins, it is the practice to remove the tire before forcing out old pins or pressing in new ones.

Taking a number of driving wheels to be re-fitted with new pins it will be found that the holes in the crankpin boss on the wheels will vary $\frac{1}{64}$ in. in diameter or more and as a consequence each hole must be measured accurately with an inside micrometer for the sizing of the crankpin to give the necessary press fit allowance. From this measurement the outside micrometers may be set to size for the pin diameter.

The Use of the Rolling Tool in the Lathe

The burnishing tool or roller is commonly employed in railroad shops for such work as finishing axle journals, piston rods, crankpins, etc. An application of this kind to a crankpin is shown in Fig. 6. The pin is here shown gripped at one end in a four-jaw chuck while the other end is carried by the tail center of the lathe. The roller is seen in operation on the side rod bearing of the pin.

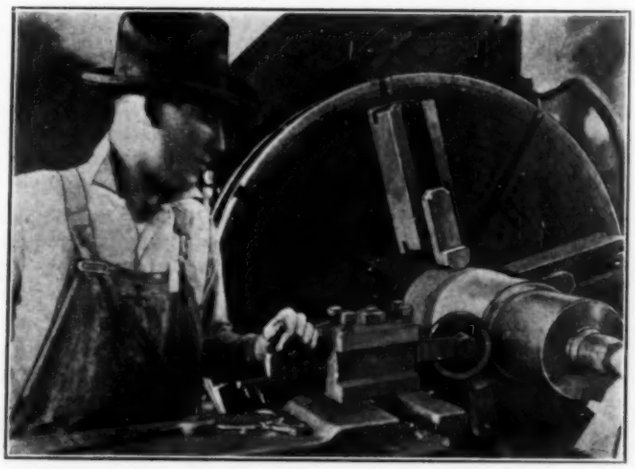


FIG. 6. ROLLER OR BURNISHING TOOL AND APPLICATION THEREOF

The burnishing tools or rollers are usually made up of a single roller in a heavy holder for the lathe toolpost. The speed of operation at this shop is somewhat higher than the cutting speed for turning and will run 75 to 90 ft. per minute depending upon the diameter of the crankpin. The amount of metal compressed is about 0.006 in. so that if the turning is smooth one passage of the roller is sufficient. Where $\frac{1}{32}$ in. of metal is left after turning the roller is fed across the work twice, with a feed of $\frac{1}{16}$ in. per revolution of the work.

The roller is 4 in. in diameter by $\frac{3}{4}$ in. face and is made of tool steel hardened and ground inside for the spindle bearing surface and ground outside for the working surface. It is provided with an oil hole and a channel for lubrication of the spindle bearing and the outside of the roller and the surface of the work are well oiled during the burnishing process. This type of roller forms a smooth surface. The metal is compressed to a tough burnished skin well suited to resisting wear and giving smooth operating conditions. There has long been discussion in railroad shops over the respective merits of the rolling and grinding processes for this kind of work. Many mechanics maintain that the burnished rolled surface gives the greater resistance to wear and smoother running conditions. On the other hand, advocates of grinding say that the abrasive process gives a more accurate surface and that after the pin has become worn in heavy service and it is again trued up by some form of turning machine, the original rolled surface is lost anyway.

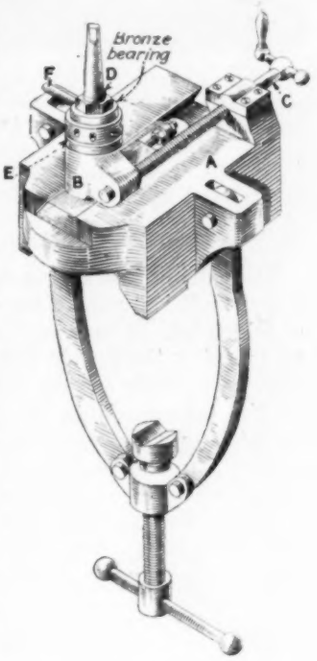


FIG. 7. PORTABLE KEYWAY CUTTERS FOR AXLES

The line drawing, Fig. 7, shows a portable device for milling the keyways for eccentrics on driving axles from 7 to 9½ in. in diameter. The frame *A* clamps over the axle and carries at the top a horizontal, sliding head *B* which is operated by handle and screw *C* to feed the end mill along the work in a path parallel to the axis of the axle. The spindle *D* for the end mill is adapted to be driven by an air motor. This spindle is mounted in a quill or sleeve *E* which is provided with a bronze bushing to form a bearing for the spindle. Sleeve *E*, which carries the cutter, is adjusted up and down in sliding head *B* by means of pin holes in the enlarged head at the upper end. The position of the sleeve and cutter as set for a given depth of cut is maintained by the clamp device *F* which is threaded internally to act as a locknut on the sleeve.

Dies for removing burrs from threads on crankpins are made of soft steel for the body. The bodies are made in halves, which are tongued together and secured by $\frac{5}{8}$-in. bolts and nuts. Each half of the body is provided with three radial slots cut $\frac{1}{4}$ in. wide x $\frac{3}{8}$ in. deep to receive the inserted chasers. The chasers are

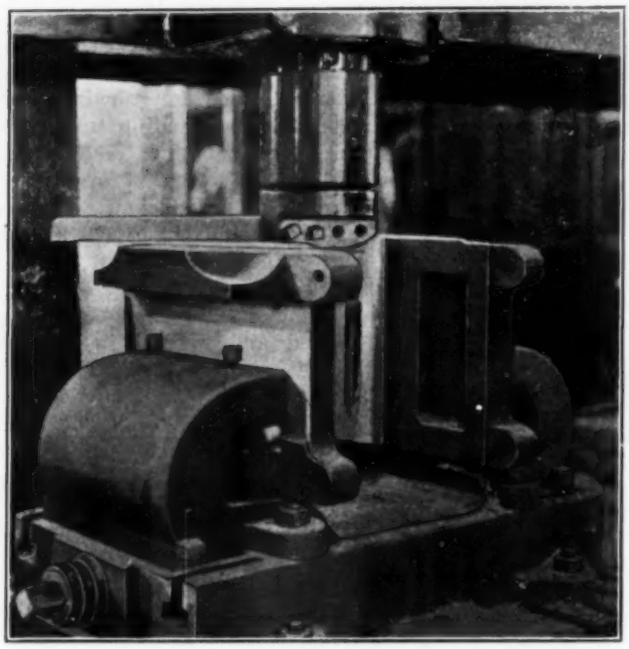


FIG. 8. FACING TOOL FOR DRIVING-BOX AND METHOD OF GRIPPING WORK WHILE TAKING A CUT OVER 10 IN. WIDE

$\frac{1}{4}$ x $\frac{1}{2}$ in. x $1\frac{3}{4}$ in. long. Two 1-in. x $13\frac{3}{4}$-in. handles are tapped in from opposite sides of the die body.

Driving Box Tool

The boring and facing of driving boxes at this shop is accomplished with a two-spindle machine, one spindle of which will be seen in Fig. 8. This shows the method of gripping the box in a two-jaw fixture which centers the work while boring out the brass. The long tool in the spindle chuck is seen in operation facing the broad lateral bearing which is babbitted into channels formed in the end of the box. The facing of the broad surface is done with the spindle running 65 r.p.m. After the face has been machined about to the desired thickness the spindle is stopped and then started again very slowly and allowed to make a couple of

SHRINKAGE ALLOWANCES FOR DRIVING WHEEL CENTERS AND TIRES

Nominal O.D., in In.	O.D. of Wheel Center	I.D. to to Bore Tire	Nearest Size in 64ths	Shrinkage Allowances
45	38	37.9603	37-31/32	0.0397
51	44	43.9505	43-61/64	0.0495
55	48	47.9500	47-61/64	0.0500
57	50	49.9406	49-15/16	0.0594
63	56	55.9308	55-59/64	0.0692
69	62	61.9209	61-59/64	0.0791
73	66	65.9144	65-29/32	0.0856
77	70	69.9078	69-29/32	0.0921
79	72	71.9045	71-29/32	0.0955
81	74	73.9012	73-29/32	0.0988
84	78	77.8947	77-59/64	0.1053

revolutions at a low speed to just scrape the surface and give it a smooth finish free from chatter marks. The length of the cutting portion of the facing tool is over 10 in. It has a slight clearance and a cutting lip is formed by making a half-round groove along the length of the cutting edge to give a keen cutting action.

The boring tool which machines the inside diameter of the brass is rotated at the same speed as the facing tool and is given a feed of $\frac{1}{32}$ in., two cuts being taken. About $\frac{1}{16}$ in. in depth is taken for the roughing cut and $\frac{1}{32}$ in. for finishing. The boring tool has a special guard which is made of sheet metal and has a hinged flap at the front. After the boring operation has been started the flap is dropped to inclose the work and tool and so prevent chips from flying. After the boring is completed the guard is lifted clear leaving the work as shown in Fig. 8. with the surface clear for the facing and corner rounding operations. The latter is accomplished with a tool like the boring cutter but having a liberal fillet to sweep out the corner of the brass to the desired radius.

Give a Man a Chance

By Ira E. Andrew

In the month of January, 1920, having recently been released from the Army I took the position as foreman of the tool department in a machine tool building plant where there was a force of about ten toolmakers. My first job was to make myself known to the men and to find out each man's ability and experience. I found by spending about a week's time with them that there were about five good men and two or three would need a good part of my time. I commenced by giving each man a chance at different work on fixtures and all around tool work, making it a point to tell him before giving him a fixture or tool to build, that I was there to instruct him and to help in every way I could on the difficult parts, such as figuring out angles, etc. Then I would give the man the prints and assembly drawing going over each detail and explaining it to him. By this method I found that several of the men had only operated a lathe or milling machine. Many of them could not lay off and bottom a job to save their souls.

In a short time I had every man on the job taught the operation of each machine and how to set up a job so that at the end of three months most of them could produce very close and accurate work.

I found by this method I had built up a good set of workmen for the concern and I found also that the men were more willing and were glad to do most anything I asked them to do. In a short time fellows that had only operated a lathe were able to do most anything and were drawing a larger pay than they had been able to do before.

I think if a few foremen I know would spend more time in helping the men under them they would find the men more capable and willing to help their foreman over hard jobs some day and be more valuable than lathe or milling machine hands.

"Give a man a chance; he is human like the rest of us" is my motto.

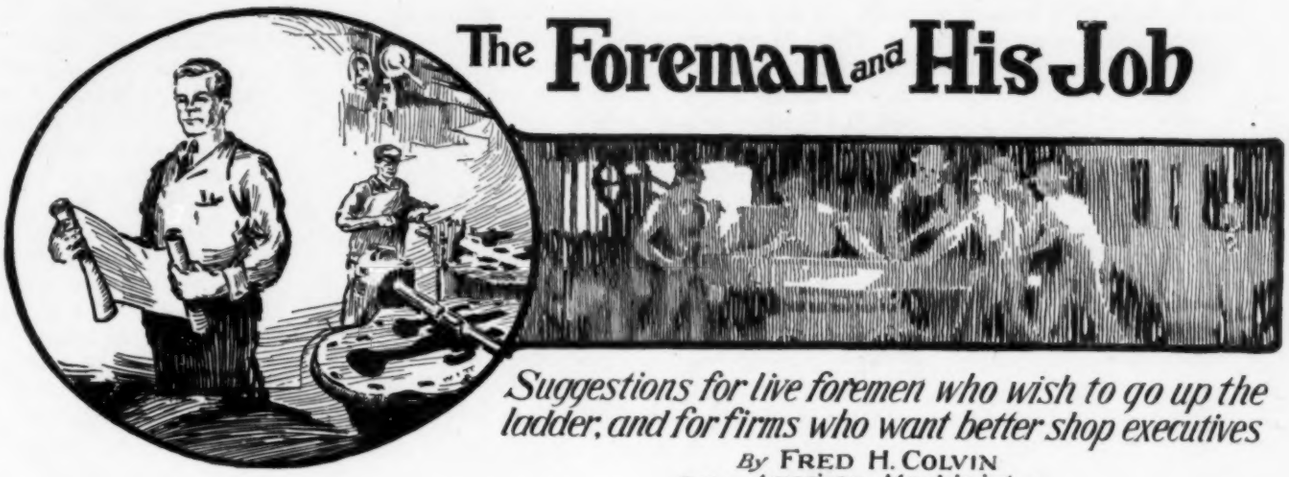
Identifying Steels

By John Homewood

In order that proper heat-treatment may be given to different kinds of steels, distinguishing marks of colors are placed upon the bar by various users. These usually consists of a color system that varies in different shops.

Each manufacturer of steel takes a certain pride in his particular grade and welcomes any effort to segregate it. It seems to the writer that the manufacturer could go a little farther and have his distinct symbol impressed upon the steel during its final rolling or by a separate operation. This identifying impression should extend throughout the length of the bar so that, no matter how small the piece, it could be recognized without the aid of tests.

This would protect the manufacturer of the steel and would be a great help to the user.



The Foreman and His Job

Suggestions for live foremen who wish to go up the ladder, and for firms who want better shop executives

By FRED H. COLVIN
Editor, American Machinist

FIRST impressions do much in forming opinions and have a direct bearing in the shop as well as elsewhere. The new man's treatment the first day in the shop can easily affect his attitude toward the men and the shop itself. It can enlist the man's best efforts or antagonize him, depending on the way he is received.

One of the best ways of considering such a problem is to put yourself in the place of the stranger who is coming in, and think how you would like to be treated under similar conditions. You would want to feel that you were welcome but it would be embarassing to have a great fuss made over you. You would not mind a joke at your expense, but it would set much better after you had become acquainted than it would the very first day you were there. You don't want to be either fussed over or neglected, but you do want to feel as soon as possible that you are one of the family and that you are not under suspicion of any kind.

Much of the feeling of strangeness which any man feels in a new job can be dispelled by a little thought and care on the part of the foreman and of the men. And in this the men are very apt to reflect the attitude of mind of those higher up. Much of the neglect of consideration for the new man however, comes from thoughtlessness, rather than any desire to be disagreeable or unfriendly. The average man means to play square but he is frequently unkind if not positively cruel, from a failure to appreciate the new man's point of view, an inability to put himself in the other man's shoes.

In shops where they consider men as "hands," or as sort of animated attachments for the machinery, practically no attention is paid to the new man. He is seldom welcomed in any way but is left to his own resources and made, quite unconsciously, to feel that he is an outsider. Such an attitude costs real money in lessened production and in the lack of interest which it creates. Just how much this amounts to is extremely difficult to say but there can be no question as to its having its effect.

Showing the Plant

A few shops go to the other extreme and send a new man with a guide to inspect the whole shop before he starts to work. He gets the atmosphere of the whole place, sees the kind of work that is being done and imbibes the spirit of the institution from the guide. He is shown the location of the hospital; the locker rooms, wash rooms, toilets, shower baths if there are any, and this attention gets him into the right spirit before he starts to work. When he finally lands in his department to begin work the foreman greets him pleasantly, introduces him to the other men and starts him at work with as little disturbance as possible.

Neither the foreman nor the men watch the new man very closely in this kind of a shop. We all know how nervous it makes many men to be under close scrutiny especially when the work, the machine and the surroundings are all new. Any instruction necessary is given as pleasantly as possible, suggestions are given as to the peculiarities of the work or of the machine and then, so far as possible, the new man is let alone. With this kind of treatment the new man does not hesitate to ask necessary questions, either of the foreman or of the men. With the proper spirit in the shop, and this must always be reflected from the management down, a new man will not be allowed to make many mistakes as the men will give him all the assistance possible. This greatly reduces the amount of spoiled work and consequently increases the output of the shop.

SHOWING THE NEW MAN OVER THE SHOP

There are, of course, many shops where it may not seem advisable to go to this extreme of conducting new men on a tour through every department. But it is much better to err on the side of paying too much attention rather than of not paying enough to get a man well started on the new job. The main thing is to make the man feel at home, to avoid the feeling of strangeness so far as possible. And when this comes from both the foreman and the men themselves, it adds more than we may think to the output of the department.

The least that can decently be done however is to send a messenger with the new man and introduce him

to his foreman in a human manner. It smoothes the way for future pleasant relations. There is no excuse for sending a new man wandering around by himself, trying to locate his foreman and his department.

No one expects or wants the men in any shop or any department to be angels and to refrain from a little harmless joking or "kidding" as it has come to be called. When joking is done in a friendly spirit it helps to smooth the serious spots in life which all encounter from time to time. But unpleasant hazing of the new man is a dangerous experiment in most cases, and does not add either to the harmony or to the output of the department.

If the shop has any special sort of system, and most shops have whether they always know it or not, it is time well spent in making clear to the new man just what his part in the plan is. He must know where he fits in if he is to merge into the organization without disturbing is equilibrium. If there is any special method of payment, any bonus system, any mutual aid or similar organization, he should know all about it before he starts in. The more he knows about the plant, assuming of course that it is really a good place to work, the more efficient he will be and the more valuable to himself and to you.

The Foreman's Influence

The foreman who has been loyal to his job and has never tried to put over anything which was not fair, can be a tremendous force for good in introducing any new plan or method, whether this be a question of wage payment or the introduction of a new machine. And in the ever changing problem of human relationship in and out of the shop, this is an important function.

Many new plans are being considered, a lot of them along very advanced lines which will go far to improving relations in many industries. Some of these plans include various kinds of bonuses; sometimes the purchase of stock; health and accident insurance; building or housing projects and similar plans. In all of these schemes, and many of them are good from every point of view, it is first necessary to "sell" the idea to the men, in other words to make them see its advantages so that they will *want* it rather than to have them *accept* it, perhaps under protest.

The first thing for a foreman to do is to study the proposed plan and convince himself that it is all that it is claimed, all that it appears. If any point is not clear, he should find out all about it. In other words he must first sell the idea to himself, must thoroughly believe in it, before he attempts to sell the plan to his men. He must remember that his reputation for honesty and square dealing is at stake, and that this is far more important than any job can be. Under no circumstances must he do anything which might lose the confidence which is reposed in him.

If it is a question of a bonus plan or piece-rate, he must be prepared to hear both sides, to discuss both sides of the question with the utmost frankness and show in every way that he means to play fair, clear down to the last detail. Any foreman who has established a reputation for fairness in such matters will find that he can wield a big influence for good along many lines, and make himself more valuable by so doing

For his own guidance in judging the merits of such cases it is well for the foreman to consider carefully some of the outstanding traits of human character. Even if some of his experiences have made him pessimistic he should remember that the average man plays the game squarely, as he sees it, else we couldn't do business on a credit system as we do. On the other hand he must remember that mighty few men are so constituted that they can look at things in quite the same light when they have no financial interest at stake. This does not by any means imply dishonesty, but the risk of something in the way of money gives almost any man a keener sense of responsibility which it is very difficult to get in any other way.

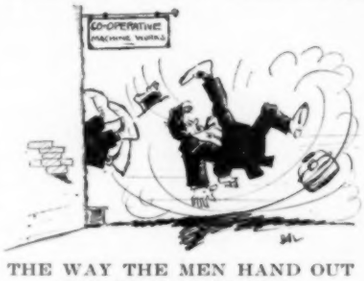
GIVING THE NEW PLAN THE "ONCE-OVER"

It may be used as a principle that men will take more interest in anything in which they are financially interested. And this applies equally to bonuses for work done, to athletic and other associations, to insurance, etc. And it is not entirely on account of the amount of money involved but rather because a feeling of responsibility has been aroused.

This factor may also be utilized in extending the self-governing principle in the shop, by making the actions of the group affect the individuals which comprise it in some definite and concrete manner. One of the simplest examples of this is the use of the group or gang bonus, which makes the bonus that comes to each man depend upon the ouput of the group or gang rather than solely on the efforts of the individual. Some object to this principle as subordinating the individual effort. But it is not the work done by any one man in a group that counts, but rather the amount of completed and finished product that brings the money into the treasury.

Every Man a Sub-foreman

The great beauty of the group bonus idea, without regard as to the details with which it is worked out, is that it tends to make the group self governing and removes much of the "bossing" function of the foreman. Where the bonus or extra reward depends on the combined efforts of the whole group, every man in it becomes a sub-foreman and does all in his power to prevent anyone falling down on the job. If there is any good reason for a man falling behind with his work the rest of the gang will pitch in and help him out. But if it is a case of loafing on the job, there will be no need for the boss to fire him. The men will attend to that.



THE WAY THE MEN HAND OUT THE BLUE ENVELOPE

This same principle can be applied to many phases of shop government, and it has its good points. It is the same in the case of sick benefits from a mutual aid society of any kind, where the men pay all or part of

the dues. The men themselves can be depended upon to prevent any malingering, or playing off in order to collect dues for sick benefits.

In the same way some shops plan to have the men take a hand in the deciding of piece-rates, in methods of doing new jobs and in the hiring and firing of men. This may sound like handing the shop management over to the men but it isn't so much so as it may seem. And it makes all decisions a part of the day's work with the men. When some of their own number have a hand in making decisions as to rates, etc., there is little excuse to find fault with them.

One of the large department stores in Boston, Filenes, has worked out a rather interesting development of this method in connection with the discharge of any of the working force. If the men or women discharged feel that they have not had a square deal, they can enter a protest and ask for a hearing before a committee. They can be represented by any counsel they desire. The committee decides as to the justice of the discharge and its decision is final. *And every member of the committee is an employee.*

This might sound dangerous, but it has been in use for a number of years to the satisfaction of both sides. A noted jurist who examined much of the evidence brought before this committee, considers that the decisions have, on the whole, been as fair as could be expected in any court of justice.

Some Features of Forced Lubrication

SPECIAL CORRESPONDENCE

The problem of lubrication is of vital importance to the life and satisfactory performance of any machine. This is particularly true in the case of high-speed machinery and the experience of the automobile engineer, driver and mechanic has a direct bearing on the subject.

The use of high-speed, heavy-duty motors has practically compelled the use of forced-feed lubrication by means of the hollow crankshaft. Even the lower priced motors have been forced to this method in some cases. But the practice differs widely both as to the manner of handling the flow of oil and the kind of bearings used on the pins and shaft.

In theory the oil under pressure should form and maintain an oil film between the bearing surfaces. And in the most carefully built motors there is a definite allowance or clearance between these surfaces to be occupied by the oil. This allowance varies from 0.0015 to 0.0025 in., and with heavy oil pressure this allowance does not produce a loose bearing. Without it the bearing must be practically metal to metal to avoid a knock or pound.

The maintenance of this oil film under various running conditions is something of a problem owing to the varying expansion of the different metals used. But its existence must be a reality when we learn of motors which have run over 150,000 miles before it became necessary to take up the bearings.

Just where and how to introduce the oil to the bearing is another problem. In the case of crankpin bearings, it is found best to drill the oil hole in the pin at such an angle to the throw as will feed the oil to that part of the bearing which is at the least pressure, or at least not to feed at the point which will be up when the piston receives either the compression or the explosion of the fuel.

The question of grooves in the bearing is also under dispute. Some of the best motors not only omit oil grooves of all kinds but have no space at the joint between cap and rod. This is accomplished either by omitting all shims or by using shims with a babbitt face and boring them with the rod so as to present an unbroken surface to the pin and the oil film.

IMPORTANCE OF END CLEARANCE

End clearance in a bearing must also be considered. It must be large enough at its highest temperature to allow sufficient oil to flow to keep the bearing cool. On some motors this flow of oil is sometimes four or five times the capacity of the crankcase per minute. In one case, with a normal supply of 1½ gal. in the crankcase, the maximum oil flow is 6 to 8 gal. per minute when the motor is under severe load.

The importance of this end clearance was demonstrated at some tests of aluminum connecting rods in a racing-car motor. The pin bore directly in the aluminum rod and the first rods failed because the ends of the bearing had expanded lengthwise, shut off the oil flow and seized the shoulders at the end of the pin. By allowing sufficient end clearance it was found that an oil film of practically constant thickness could be maintained at any temperature. The increasing heat expands the bearing diameter of the rod, and if the metal can flow endwise, the bearing will maintain its oil film.

Another important point is the dissipation of heat generated by the revolving pin or shaft. Large shafts are desirable to avoid springing and "whipping" but they can only be kept cool enough to run by maintaining a constantly flowing oil film and also by paying proper attention to the bearings themselves.

Here again racing-motor practice and experience has been of great value. It is stated that no motor can live through a 500-mile race with bearing shells in the rods unless extreme precaution is taken. In many racing motors the bearing metal is cast into the rod, perferably under pressure. Some use a shell bearing but solder it into the rod, first tinning the rod.

Where bushings or shells are not soldered in place, extreme care is taken to be sure that they have a full, smooth bearing in the rod and that no dirt or even oil gets on these surfaces. Racing-motor mechanics are very particular to clean their hands thoroughly before putting the shells in place. Then they clean the rod and bearing in gasoline, let this evaporate and put the shell solidly in place immediately.

All this precaution is to insure maximum radiation or transference of heat through the rod. The rod with the bearing cast or soldered into place is considered the best for long runs and heavy duty.

In some high-grade motors the main bearings are poured into a cast-iron or steel shell so as to insure an expansion in the bearing which more nearly equals that of the shaft itself than where bronze is used. The great object is to maintain an oil film of constant thickness and of a volume which bears a direct relation to the work being done by the motor.

The effect of these studies and experiments has been to greatly increase the life and reliability of motors. Can we apply some of these lessons to similar conditions in machine-tool work? We lack the heat due to the burning of fuel in the internal-combustion motor, but we do get heat from various sources, such as electric motors. How far can we use pressure lubrication on machine tools to advantage?

A History of Post-War Crises—II

The Period from 1860 to the World War—The Effects of War on Finance and Industry—A Summary of Post-War Booms and Crises

By H. H. MANCHESTER

WHILE it is perfectly evident that in the post-war crises considered thus far, there have appeared similar features so regularly as to become almost monotonous, it might be argued that the underlying industrial systems then were so different that the periods reviewed furnish no analogy to the present. But we shall find the same common features reappearing in the crises since 1860. This suggests that the course of these events depends more upon human psychology, which always remains the same, than it does upon the methods of industry.

If this is true the argument from analogy between the past and the present is merely taking it for granted that mankind in general will act very much the same in the near future as it has in the past in a similar series of events.

The English Crisis of 1866

In 1866 in England, there was a severe crisis which may be laid to the over-speculation caused by the Civil War in America, and the Seven Weeks' War in Europe between Prussia and Austria. The crisis seems to have come on unexpectedly. "During the early part of the year," according to the "Annual Register," "it was commonly asserted that trade was healthy," though the "Register" stated that the crisis which followed, "was the inevitable reaction from the speculative mania and inflated commercial transactions of the preceding year, which had launched so many shallow and fallacious schemes upon the world."

In April a speculative railway failed, and on the tenth of May, "the stoppage of the great discount establishment of Overend & Gurney produced universal consternation. . . . No single bankruptcy perhaps, ever caused so great a shock to credit. The following day produced the wildest agitation which has ever been known in the city, and the government was compelled, as in 1847 and 1857, to authorize the Bank of England to issue notes beyond the legal limit. . . . The rate of 10 per cent discount lasted from the eleventh of May to the seventeenth of August. . . . For some months after the panic, English credit fell into entire disrepute on the continent."

The principal cause of the crisis was probably the rapid expansion of trade unsecured by the provision of an adequate pecuniary reserve.

The period required for recovery in which we are especially interested, may be traced in the reviews of the time.

Of 1867 the "Annual Register" said, "The financial collapse continued with little abatement throughout the year. Commerce and credit did not display their wonted elasticity in recovering from such disorder." The *London Times* of Jan. 1, 1868, declared: "The war in Germany precipitated a break-up of all the general financial speculations of Europe . . . railway revelations have since spread ruin where all parties thought themselves secure."

Concerning 1868 the "Annual Register" declared: "The commercial depression which has lasted since the spring of 1866 still continues to be felt." The *London Times*, however, said that there had been "an uninterrupted though slow recovery of trade."

Even in 1869, times seem to have been scarcely normal, for the *London Economist* stated: "The return to financial and commercial activity during the year which has just passed over our heads, has been slow." This is evident from the record of price changes in England. On 31 important articles with the prices of 1860 considered as 100, those of 1866 were 133, those of 1867 were 115, and those of 1868 were 99. It was not until 1869 that prices began to rise again, then reaching 105.

In the United States the years immediately following the Civil War showed ups and downs but no crisis.

Of 1865, in April of which the war closed, Dun's annual circular declared: "The year which has just closed, taken as a whole, has been one of remarkable prosperity in all commercial pursuits." Concerning 1866, the year of the English panic, Dun's circular said: "It may be safely said of 1866, never before was there less money realized from a volume of trade of the same extent. . . . Generally speaking, manufacturers have produced more than the demand of the market, and importers have imported largely in excess of their requirements. . . . With the return of peace the tendency toward undue credit transactions is again becoming apparent and it is much to be feared that the excessive stocks both of manufactured and imported goods have recently caused an expansion in this direction which if persisted in may result disastrously."

Failures and Liabilities

1865	530	17,625,000
1866	632	47,433,000
1867	2,386	86,218,000
1868	2,197	57,275,000

Prices with those of 1860 considered as 100 were in greenbacks, 217 for 1865, 191 for 1866, and 172 for 1867. Wages in the meantime were in greenbacks, 143 for 1865, 152 for 1866, and 158 for 1867.

It is clear from the evidence given above, that there was nothing in the United States in the first few years after the Civil War, which could really be called a crisis—nothing at all comparable to the English crisis of 1866.

The nearest approach to a panic in this period in the United States, was the Black Friday which took place Sept. 24, 1869. This resulted from an attempt to corner gold by Jay Gould and James Fiske. At first this was apparently successful. Gold advanced on Thursday from 137 to 144, and on Friday to 162. The Government then offered to sell four millions, which broke the corner, and reduced the premium on gold to 133. The panic, however, left some fifty failures in its wake. Since those who were boosting gold did it on the strength of the irredeemability of the greenbacks, the breaking of the corner was a triumph for those who believed in the ability of the Government eventually to redeem its promises. In other words it was a victory for the optimists as against the pessimists.

The crisis of 1873 may be considered a delayed explosion resulting from the over-activity and speculation which followed the Civil War, but it must be kept in mind that the first manifestations of this crisis were in Europe, and in Austria and Germany were the result of the wild stock jobbing which followed the Franco-Prussian War.

The first sign of the panic occurred in Vienna. In the five years before 1873 state concessions had been given to more than a thousand corporations with a capitalization of one and one-half billion dollars. The corporation form of business was just being introduced and was being developed to an extreme. Failures began in Vienna the last of April, and on May 10 occurred a panic which soon spread all over Austria. Committees of assistance were formed in all the principal towns, which guaranteed funds to those worthy of credit and did considerable good, but the panic had gone too far to be stopped in Austria or for that matter in Europe.

Effects of Franco-Prussian War on Germany

The next country to feel its effects was Germany. The quick winning of the war against France had produced the greatest commercial, as well as political enthusiasm in Germany. According to the *Bankers' Magazine* of London, "When these inflated notions were culminating, French milliards were poured into the German treasury. With these funds the most extravagant notions of wealth and of future progress took possession of the new empire . . . and almost immediately a violent fever of excitements began."

Another contemporary review likewise laid the source of the trouble to the indemnity: "Anomolous as such a proposition appears at first sight, the payment of the French indemnity has been the leading stimulus of the enormous amount of unsound financial enterprises which have been started in Germany. . . . Endless banking, finance, and other companies were floated; the most glowing prospects were everywhere held out; the wildest adventures were eagerly patronized in the general rush for gain."

The first important German city to be affected was Frankfort; then Hamburg and Berlin. In some cases bank shares dropped over 80 per cent, while the stocks of 34 companies declined about 70 per cent. The general collapse lasted two months and affected the whole country, while the depression which followed lasted several years.

Conditions in America Prior to 1872

In spite of a fall in prices after the Civil War, there is no doubt that times continued very good in the United States until 1872. Manufactures in the United States were more than twice as much in 1870 as ten years before, while New York bank clearings were almost three times as much. The Civil War had shown the tremendous importance of railroads, and especially of connecting the Pacific Coast with the East. The Homestead Act of 1862 helped greatly to settle the West and gave another impetus to the building of railroads. Altogether the railroad mileage increased from 35,000 in 1865 to 53,000 in 1870, and to more than 72,000 in 1873, an increase of over 100 per cent in eight years.

In 1873, however, when the financial panic abroad led to a more rigid examination of American enterprises it began to be realized that while the new American railraods would eventually pay it would be a number of years before they could yield a dividend. Investors in Amsterdam, Hamburg, and other northern European cities who had invested heavily in American securities, were compelled by the panic there to throw them on the market and this helped to spread the crisis to America.

From the description in the *Bankers' Magazine*, the crisis here burst suddenly:

"On Saturday, Sept. 13, Wall Street was startled by the failure of Kenyon, Cox & Co., bankers. This house was regarded as among the strongest, but having made large advances to the Canada Southern R.R. Co., was unable to meet its engagements. A decline in the price of stocks followed and much uneasiness ensued. . . .

"On Thursday morning, the eighteenth . . . when it was reported that the well-known firm of Jay Cooke & Co. had suspended, the excitement became intense. . . . The cause assigned is their large investments in railroad bonds, particularly those of the Northern Pacific." Many suspensions followed, and at noon Saturday the twentieth, the stock exchange was closed until further notice.

The effect of the panic of 1873, probably because the boom which it burst was very widely extended, endured longer than usual and developed into several years of hard times.

An indication of how slowly conditions improved is given by the statistics on failures. In 1872 these mounted to $121,000,000, in 1873 to $228,000,000, almost twice as much, and while they dropped to $155,000,000 in 1874, they rose again to $202,000,000 in 1875.

Prices in gold which had reached their peak in 1866 had dropped gradually until 1869 and then risen again until 1872. From this date they dropped steadily until 1879 when they reached a point somewhat below the 1860 level. Wages in gold reached their highest point in 1872, which was 50 per cent above the level of 1860, and then dropped gradually until 1876, when they were still 35 per cent above the 1860 level.

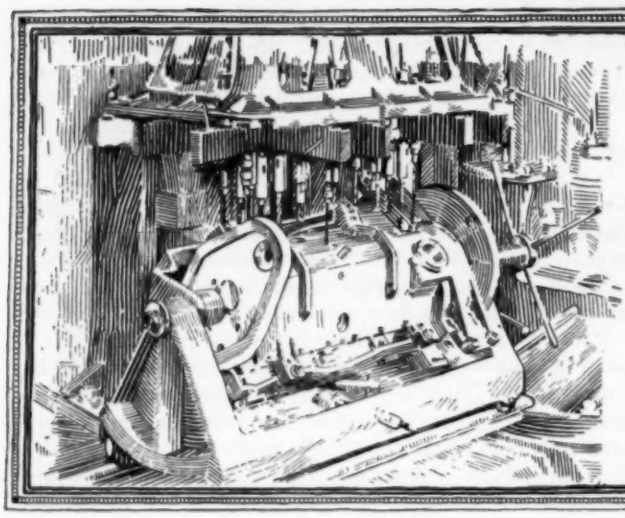
Post-War Booms and Crises Regular Occurences

In order to apply the data we have gathered thus far to the present situation, it is best to summarize the general principles discovered. The most obvious fact is that all of the big wars for the past five hundred years have been followed by boom times that have almost inevitably been short and in most cases have led to some sort of crisis, or at least to a sudden fall in prices which have returned more or less nearly to the pre-war level.

The reason for this seems to be that during the war there is naturally a concentration of production on war supplies and a restriction in non-war fields. When the war is ended, although the production of munitions ceases, the peace industries leap forward in a sudden reaction which carries prices to heights that cannot be maintained. The market is usually over-estimated and a drop follows which puts industry back to nearly a pre-war level.

In almost every case the boom has started a year or two after the war, has lasted for a year or so, and then broken. The subsequent fall in prices has not taken longer than between one and two years; after which conditions became normal once more. The fall in prices at the end of the boom has frequently been more severe than necessary—in other words, after a severe disturbance the pendulum always swings too far.

Wages in contrast with prices have regularly been slower to rise and slower to drop. It has usually required a severe crisis and an extended period of hard times to bring them down to the previous level.



Tool Engineering

By
Albert A. Dowd and Frank W. Curtis
President and Chief Engineer
Albert A. Dowd Engineering Co., New York City

Closed Jigs for Angular and Straight Holes—Locating and Assembling Jigs —An Example for Practice

WHEN large castings are to be drilled from several sides, the jig is frequently made in trunnion form, but when the work is comparatively small it is customary to provide for drilling the holes from various directions, by making it possible to set the jig up in different positions as required. When some holes are to be drilled straight and others at an angle in the same jig, care must be taken that projecting knobs, setscrews or other protuberances, do not strike the surface on which the jig is resting. In Fig. 78 a closed jig is shown for the work *A* which has been previously machined in a turret-lathe operation at *B*, *C*, *D* and *E*. There are four holes to be drilled at *F*, arranged at the four corners of a rectangle. There is also an angular hole to be drilled at *G*. The work is located on the fixed plug *H* at one end of the jig and rests on the hardened ring *K*. At the other end a plug *L* is used as a locater. It will be noted that this plug is arranged so that it can be operated quickly. The method used is an application of the familiar form of bayonet-lock, the plug being slotted at *M*, and the slot having an angularity at *N* to provide for locking by means of the teat screw *O* which engages with the slot.

As it is necessary to locate the finished pad containing the four holes *F* in such a way that the holes mentioned will be square with the finished surface, a locater must be provided. The form of locater used is shown in an enlarged section. The plug *P* is made with a double end at *Q* and *R* so that these two points bear against the casting and straighten it up in relation

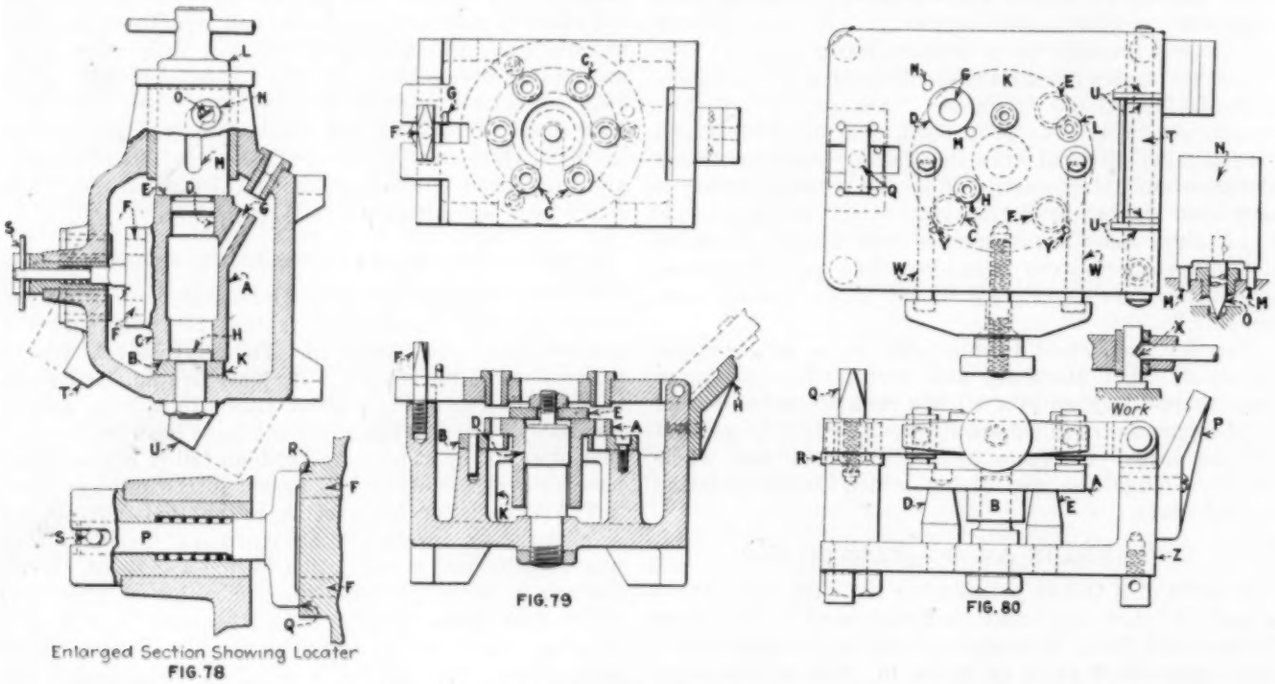


FIG. 78. CLOSED JIG FOR ANGULAR AND STRAIGHT HOLES. FIG. 79. SIMPLE TYPE OF CLOSED JIG. FIG. 80. BUILT-UP JIG OF REPRESENTATIVE TYPE

For the authors' forthcoming book. All rights reserved.

to the finished surface. The plug is mounted in a bushing and is controlled by a spring. The end of the bushing is slotted to receive a pin *S* which keeps the locater in its correct position, provides a means for withdrawing it when inserting the work, and acts as a restrainer to prevent it from coming out of the bushing. It can be seen that the action of the locater is practically automatic after the work is placed in the jig and it tends to straighten out the finished surface and thus bring it in to its true position while the plug *L* is being operated.

As originally designed four feet were provided at *T* and *U* in order to give support while drilling the angular hole *G*. The construction would be much improved by extending these feet and separating them farther, as indicated by the dotted lines, in order to give greater stability.

A conventional form of closed jig is illustrated in Fig. 79. The work *A* locates on a hardened plate *B* which is set in the body of the jig. The bushings *C* are carried in the leaf. The work locates on a central stud *D* and is clamped by means of C-washer *E*. Provision is made in the leaf for the nut on top of the C-washer in order to bring the leaf as close to the work as possible. The leaf is changed by means of a quarter-turn screw shown at *F* and a stop-pin is provided at *G*.

Attention is called to the leaf stop indicated at *H*. It is also well to note the manner in which the stud *D*, on which the work is located, is arranged and that the wall of the jig is opened up on two sides at *K* in order to provide for cleaning. It will also be seen that the work does not get a bearing on the stud *D* for its entire length as it is relieved at the lower portions, yet it gives ample surface for accurate location.

A number of units frequently used in the construction of built-up jigs have been illustrated and described in an earlier article. In the example shown in Fig. 80 some of these principles and units are illustrated.

The work *A* has been finished all over in a previous operation and it is located on the central stud *B* and also on the four pins *C*, *D*, *E* and *F*. The holes to be drilled are a blind hole at *G* and three smaller holes *H*, *K* and *L*. The depth of the blind hole is important and for this reason the leaf is provided with two hardened and ground stop-pins at *M*. The enlarged view shows the type of gage used for determining the depth of this blind hole. The hardened pins *M* act as stops for the gage block *N* and the point *O* gages the depth of the hole. If the hole is not deep enough the gage will not come down on the pins, while if it is too deep the gage can be turned around so that it will pass between the pins and strike on the sides.

This jig is provided with a leaf stop of standard form shown at *P* and the leaf is fastened by means of the quarter-turn screw *Q* and bears on the wear plates indicated at *R*. Provision is made for stopping the quarter-turn screw by means of the pin *S*. The construction of the hinge is of the approved method previously described, in which a taper pin *T* and wear plates at *U* are employed. The work is held firmly in position on the locating studs by means of a special equalizing clamp in the leaf. A sectional view of the construction is shown at *V*. It will be seen that the pins *W* are cut on an angle at the end *X* so that they exert a downward pressure on the pins which clamp the work. The action of the operating pins is limited by the slots at *Y* so that they do not disengage completely from the angular slot *X*.

This jig is built up from a standard angular plate *Z* and a number of units previously described have been used in its construction. It is an excellent form of jig because it can be made up from standard units to some extent, is very easily cleaned, quickly operated, and has every provision for adjustment and replacement to take care of wear. It may be argued that the clamping does not take place directly over the locating studs but it has been pointed out that this principle cannot always be followed, and in the case shown the work is sufficiently stiff that no danger of distortion need be apprehended.

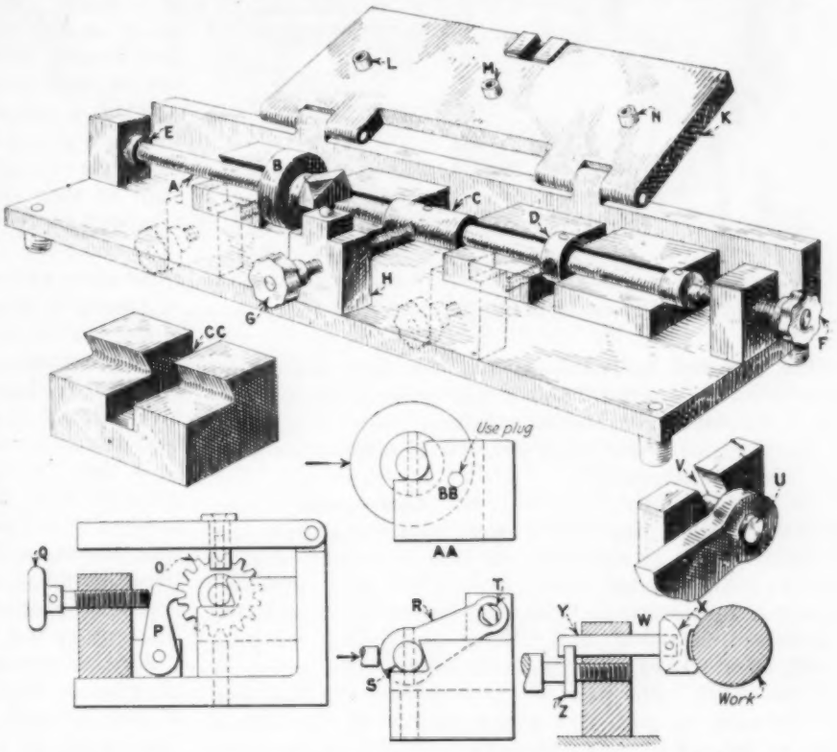


FIG. 81. LOCATING AND ASSEMBLING JIG FOR SHAFT AND COLLARS

Locating and Assembling Jigs

It is often necessary to assemble a number of pieces on a shaft in a certain relation to each other both radially and longitudinally. When this is necessary it is advisable to make use of a locating jig, an example of which is shown in Fig. 81. The work consists of a shaft *A* to which are applied several collars at *B*, *C* and *D*, fastened to the shaft by means of taper pins. The jig is of cast iron and the various units necessary are mounted on it. The shaft *A*, with collars *B*, *C* and *D* loosely assembled on it, is forced up against the hardened stud *E* by means of the thumbscrew *F*. Each of the collars is held in position and prevented from turning by means of a screw *G* mounted in a block *H*. The screws force the shaft over into V-blocks and longi-

tudinal location of the various collars is assured by the space between the various blocks.

The principle shown at *G* is also used at *B* and *D*, but the position of the unit is shown in dotted lines in order to make the illustration more clear. The leaf *K* is provided with bushings at *L*, *M* and *N* by means of which the holes are properly located. The work

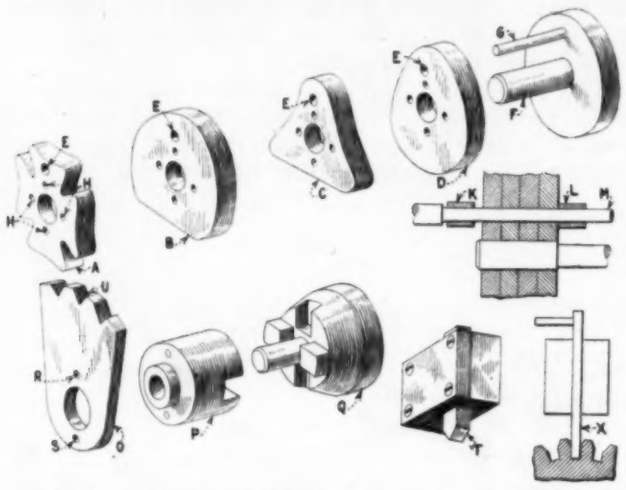


FIG. 82. EXAMPLES FOR PRACTICE IN DESIGNING LOCATING JIGS

being clamped independently of the leaf, a tapered reamer can be used to finish the holes after the leaf has been thrown back into the position shown. Applications of the principles shown can be used for other work of similar character.

It is frequently necessary to locate gears, cams, levers, or other parts on a shaft in a certain relation to each other. In cases of this kind it may be possible to use a jig similar to that shown but with different schemes for locating. The gear shown at *O* is to be assembled on a shaft and it is necessary that the gear teeth should have a certain relation to other members on the shaft. The pawl *P*, used to give this location, is operated by means of a thumbscrew *Q*. A spring can be applied to throw the pawl out of location when the screw is released.

Another example is shown at *R*. This is a lever which must be located on the shaft at *S* and in the correct angular relation to the hole at *T*. It is a simple matter to provide a pin at *T* to give the desired position, the pin being cut away as indicated in order to provide for slight variations between the center distances of the two holes. When pressure is applied in the direction indicated by the arrows the shaft will be forced into the V-block and the lever will be held in its correct position.

There are some cases where a pin is assembled in the lever arm as indicated at *U*. When this is the case a locating block may be slotted as at *V* to receive the pin. The angularity of this slot should be at right-angles to a center line passing through the two holes in the lever.

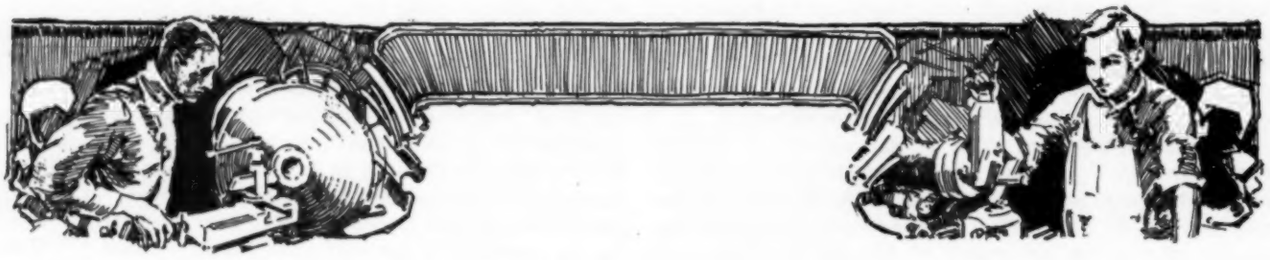
A method which can be used for locating work in a V-block is indicated at *W*. A swivel block *X* is mounted on the end of a stud *Y* and operated by means of a collar screw *Z*. This type of clamp has an advantage when it is necessary to guard against any turning action which might change the position of the work when clamping. Occasionally a collar must be located on a shaft in relation to a previously drilled hole such as that indicated at *AA*. The work can then be located in a V-block and a plug can be pushed into the collar at *BB*. This sketch also illustrates the slotting of a single V-block to provide for location instead of using several blocks as indicated on the jig. *CC* is also slotted but in a direction different from that in the example just mentioned.

When a series of parts is to be assembled such as the cams shown at *A*, *B*, *C* and *D* in Fig. 82, it is common practice to provide the cams with a driving hole such as that shown at *E* in each cam. This hole is carefully located and is used in cutting the cam and in assembling. The parts are generally set over a small plug similar to that shown at *F* and are located by means of the pin *G*. A pin of suitable size is made, either cast or built up, in such a way that the pieces are all located one over the other on the plug mentioned. A suitable clamp must be provided to hold the four pieces firmly in position. After they have been assembled the rivet holes *H* are drilled. It sometimes happens that the pin *G* is weak and is likely to be bent when in use. It is better to provide the jig with bushings as indicated at *K* and *L*. After this is done a plug *M* can be placed through all of the holes one after the other to give the correct location.

A good problem suggested here is the designing of a jig for drilling the rivet holes *H* in these cams.

Another example which offers a good problem is afforded by the parts *O*, *P* and *Q*. *O* sets over *P* and *P* over *Q*, and a locating jig is desired so that the rivet holes *R* and *S* can be drilled in their correct location. As an alternative we suggest that a locater similar to that shown at *T* can be used in the teeth *U* but if this appears too expensive a paddle gage or plug such as that shown at *X* can be used.

On certain classes of work assembling and locating jigs are of extreme importance and it is therefore a good idea for the designer to note the construction of the examples given very carefully and put into practice the various principles which have been illustrated and described. He will find it a decided advantage to design several jigs of this kind, using examples from his own practice and taking cases which are of particular interest rather than those which appear simple and easy to work out.



Programs of Apprenticeship and Special Training In Representative Corporations

By J.V.L.Morris

XIII—The Westinghouse Air Brake Co., Wilmerding, Pa.

Plan of Instruction Thorough—Number of Apprentices Small—Careful Selection of Boys—Class Work by Y.M.C.A. Director—Results of Training Excellent

IN THE plant of the Westinghouse Air Brake Co., employing a total of about 4,500 men, women and boys, there is a small but, judging by results, highly efficient apprenticeship department with an enrollment of thirty young men distributed among the three usual trades as follows: Machinists, 26; patternmakers, 2; molders, 2.

This provides a reasonable ratio of nearly one in five to the 150 toolmakers employed, but is only at the ratio of one in twenty-five to the fifty patternmakers in the works, a ratio which must be recognized as too low, since at least one apprentice to eight journeymen is quite evidently necessary to provide for replacements. As regards molders, here as in general, it has been found impossible to persuade sufficient apprentices to learn the trade in order to even provide for foreman replacements.

The general provisions for apprenticeship are under the direction of the supervisor, who devotes all of his time to this work. He is considered one of the best mechanics in the plant, and is apprentice trained. Much of the credit for the satisfactory showing of the department should be given to him. The following quotations from his program show the general plan followed:

"The machinists and patternmaking apprentices are indentured for a period of four years, or 10,000 hr. The molder apprentices are indentured for three years, or 7,200 hr. There is another class of special apprentices who are graduates of approved technical schools, and whose apprenticeship covers a period of two years; but none are at present enrolled on this basis.

"The first class, or regularly indentured, apprentices are required to be at least sixteen years of age, of good reputation and physically suited to follow the trade. All applicants are requested to present themselves for personal interview. If his general appearance is favorable and he appears to have an aptitude for mechanical work, the applicant is required to take examinations in arithmetic, spelling and writing, and must have a mark of at least 70 per cent efficiency in each study. Accuracy is one of the essential requirements in these examinations. For instance, if the applicant solves a problem, the solution must be correct in both principle and result to receive credit. In other words, if an error in multiplication is made, the applicant receives no credit whatever for the solution of that particular problem. In addition to these examinations, inquiry is made of the principal of the school from which the candidate comes as to his efficiency and general behavior, also as to how the candidate spends his evenings.

"If successful in the above examinations, he is asked

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The Westinghouse Air Brake Company

APPRENTICE APPLICATION

(To be Filled Out by the Applicant Personally)

Trade applicant desires to learn ..... Date of Application ..... 191...

Name of applicant in full ..... Date of birth ..... Age .....

Address of applicant in full ..... Are parents living .....

Father's name in full ..... Address .....

Guardian's name in full ..... Address .....

Father's occupation .....

Present occupation of applicant .....

How long since applicant attended school? ..... Where? ..... Grade? .....

How far have you studied in Arithmetic? .....

How far have you studied in Algebra? .....

How far have you studied in Geometry? .....

Have you ever had any shop experience? .....

If so where? .....

If so how long? .....

Signature of Applicant.

Approved.

Signature of Parent.

FIG. 58. FORM FOR APPLICATION FOR APPRENTICESHIP

to fill out an application blank, a copy of which is shown in Fig. 58, and which afterwards must be signed by either the parent or the guardian. If the applicant is accepted, he is indentured and arrangements are made for him to commence work. The indentured forms are made out in duplicate, one copy for the parent or guardian of the apprentice, and the other for the record and file of the company. As stated in the indenture, the first three months of service are considered as a probationary period, the continuation of the apprenticeship depending upon the progress of the apprentice in the shop and in the school.

Rates of Wages

"The wages are based upon an hourly rate, which is as follows:

"Machinists' and Patternmakers' Rate. The first six months, 14 cents per hour; the second six month, 17 cents per hour; the third six months, 19 cents per hour; the fourth six months, 22½ cents per hour; the fifth six months, 25 cents per hour; the sixth six months, 28 cents per hour, the seventh six months, 35 cents per hour; the eighth six months, 42 cents per hour. In addition to these wages, the apprentice receives bonuses as follows, provided his shop and class work records are 70 per cent or above: First year, $25; second year, $40; third year, $75; fourth year, $100, or a total of $240 in bonuses for the four years.

"Molders' Rate. The first year, 22½ cents per hour; the second year, 31 cents per hour; the third year, 39 cents per hour. In addition to these wages, the apprentice receives bonuses as follows, provided his shop and class work records are 70 per cent or above: First year, $50; second year, $100; third year, $150, or a total of $300 in bonuses for the three years.

"Reports showing the number of hours worked and the class of work performed, also the shop progress of the apprentices, are made out on a special form, being signed by the department foreman and afterwards by the apprentices themselves. They are forwarded the first of the following month to the general superintendent for approval, after which they are entered upon the office records. This arrangement requires the apprentice to sign his own record, and no records are made concerning any apprentice which are not read and signed by the apprentice. Every month a statement is forwarded to the parent or guardian of the apprentice, showing the averages attained by the young man in his studies at the apprentice school, which is conducted by the educational director of the Wilmerding Young Men's Christian Association, assisted by an engineer from the engineering department of the Westinghouse Air Brake Company. Also, at the end of each quarter, a report is mailed showing the school average for the three months and also the progress of the apprentice in the shop.

Work in the Shop

"In the shop, the apprentices are under the care of the supervisor of apprentices, and also under the foreman of the department in which the young man may be working; but the supervisor of apprentices has general charge of all the apprentices, and if they have difficulties to overcome they feel free to go to him for help and instruction. Thus, there is some one in charge of the apprentices to see that they receive the proper kind of shop training, which finally results in efficient workmen.

"The machinists' apprentice work in the shop is apportioned approximately as follows: Drill press, two months; lathe, nine months; shaper, one month; planer, two months; bench, twelve months; boring mill, three months; milling machine, nine months; drawing room, six months; and test department, four months. Total number for four years, 10,000 hours.

"The patternmakers' apprentice work is apportioned as follows: Sand papering, varnishing and plain turning, six months; plain bench work, six months; mechanical drawing (engineering office) six months; helping molder and coremaking (iron foundry) six months; pattern shop, advanced work, twenty-four months. Total number for four years, 10,000 hours.

"The molders' apprentice work in the foundry is apportioned as follows: Core making (iron foundry), 1,200 hours; cupola, 200 hr.; bench molding, 700 hr.; general molding, 4,900 hr.; general molding (brass foundry) 800 hr. Total number for the three years, 7,800 hours.

The Day School

"The Westinghouse Air Brake Co., recognizing the importance of the apprentices advancing as far as possible in their school work, instituted a day school educational department, in connection with the apprentice system which has been in force since September 1906, with very satisfactory results. The school work is conducted, as before stated, in the Wilmerding Young Men's Christian Association, and amounts to approximately eight hours per week for each apprentice, running nine months of each year of the four years, from September to July. The regular shop hourly rate is allowed while attending school."

Work in the Classes

The amount of class work is shown by the following schedule, in which the figures represent the number of hours in recitation per week:

	Monday	Wednesday	Friday
First Year	Algebra (1) Arithmetic (1) Spelling (1)	Algebra (1) Arithmetic (1) English (1)	Mechanical Drawing (4)
Second Year	Algebra (1) Physical (1) Spelling (1)	Algebra (1) English (1) Shop Math. (1)	Mechanical Drawing (3) Slide Rule (1)
	Tuesday	Thursday	Friday
Third Year	Geometry (1) Physical (1)	Shop Math. (1) Physics (1) Geometry (1)	Machine Design (1) Slide Rule (1) Shop Math. (1)
Fourth Year	Geometry (1) Electricity (1) Trigonometry (1)	Business English (1) Trigonometry (1)	Geometry (1) Machine Design (2)

One interesting feature in connection with the class work is that these classes are conducted the first hours in the morning, so that the apprentice who has class work will come into the class before he goes into the shop for the day, a feature which should result in better recitations. Also it will be seen that the apprentice is permitted to be absent from the shop three mornings a week for this school work.

"Upon satisfactorily completing the terms of the indenture, the apprentice is given a diploma properly filled out and signed by the officers of the company designated, with the company seal attached to the diploma."

The quality of the instruction in the shop and school is best shown by the product. This may be gaged from a tabulation by the supervisor of the exact location of each graduated apprentice at the present time, which list includes all of the seventy-four graduates, with the exception only of four whose location could not be dis-

covered. The writer has summarized this record as follows:

Number completing each course:			
Machinists			61
Patternmakers			7
Molders			1
Special Course in Mechanics			5
Total			74
Present employment of these graduates:			
Administrative		14	
General Manager	1		
General Superintendent	1		
Assistant General Manager	2		
Manager	1		
Superintendent Tool Design	2		
Foreman	6		
Assistant Foreman	1		
Technical		18	
Layout Engineer	1		
Efficiency Engineer	2		
Mech. Engineers & Tool Designers	3		
Instructors Manual Training	2		
Steel Inspector	2		
Physical Laboratory	3		
Draftsman	3		
Machinery Salesman	1		
Clerk, Cost Department	1		
Skilled Trades		34	
Machinist	18		
Toolmaker	6		
Patternmaker	6		
Die Maker	3		
Installer & Demonstrator	1		
Miscellaneous		2	
Physician	1		
Farmer	1		
Deceased		2	
Whereabouts Unknown		4	
Total			74

Another matter of interest brought out by this compilation of the present location of graduates is the proportion who have remained with the company. Of the seventy-two living graduates, the record shows that twenty-nine, or 40 per cent, are still in this same plant. This seems somewhat better than the condition in some plants and probably all that should be desired, as it is frequently to the apprentice's interest in acquiring a varied experience to take upon completing apprenticeship employment in several and diverse plants.

Analyzing the summary of present employment, we see that fourteen, or 20 per cent, are now holding executive or foreman positions, and that thirteen, or about the same percentage, technical positions. This shows that, in view of the fact that all these apprentice graduates are still young men, having in every case completed their apprenticeship since 1906, a very creditable number have found apprenticeship the first round of the ladder of industrial advancement. This may be accounted for in part by the careful selection of superior boys who would have gone ahead anyway; but, no doubt, in part by the greater amount of supplementary school training than is provided in many apprentice schools. It is believed, however, that much credit should be laid to the fact that good apprenticeship during the sixteen-to-twenty age-period provides the discipline and industrial intelligence that, for the purpose, cannot well be acquired by other means. Of the remainder, practically all are at skilled trades, and many of these men with maturity will doubtless advance to positions of responsibility; but, even though they do not, they are in highly useful and productive employment.

The Use of Paper and Wood in the Machine Shop

By John Mark May

The articles in the *American Machinist* by E. A. Dixie on "The Use of Paper in the Machine Shop," page 849, and by John Slocumb on "Wood Blocking and Boring-Bar Work," page 868 were both timely and interesting articles. As Mr. Dixie states that he hopes others may come forward with their knowledge of other uses for paper in the machine shop I am moved to offer my bit.

There was a great deal of trouble experienced and considerable time spent in removing a faceplate from a certain lathe. The class of work that was done on this lathe made it necessary to change from faceplate to chuck quite frequently and, I believe due to the fact that the spindle nose was fitted with a rather fine pitch thread and also that this particular lathe was used for fairly heavy work upon which good substantial cuts and feeds were used, it was a difficult job to loosen the chuck or faceplate on the spindle when a change was necessary.

A fellow workman suggested that a paper washer be placed between the collar of the spindle and the hub of the faceplate. A washer was cut from ordinary drawing paper and no further trouble was experienced. A washer would last for from about two to six changes. It would seem that in this particular instance the paper decreased instead of increased frictional resistance.

On this same lathe I frequently bored and faced bushings and cylinders in a way similar to that described by John Slocumb by using wood blocking strapped to the lathe carriage for a cradle into which the castings fitted; differing only in the respect that we used a wood block for the top, or holding down section, of the same width and thickness but somewhat shorter than the bottom pieces. This, we believed, gave us a more accurate setting due to fit on the casting secured nearly all the way around its outside surface instead of something less than half way around. This method is also more convenient for sizing for the casting fit.

On another class of work which required more than ordinary accuracy and on which there was so much machining to do that a piece was usually left in the machine over night and sometimes over a week end, it was found that sometimes the wood had changed its shape enough so that surfaces that had been finished previously did not run true with those finished later.

This error was entirely overcome by using four or more blocks bolted on separately with the end of the grain bearing against the work.

"Drill Jig for Small Pin Holes"

By F. J. Camm
Windsor, England

I was interested in the jig for small pin holes described on page 473 of *American Machinist*. I greatly fear, judging from long experience in such work, that this jig would be far from satisfactory as the bush is not carried sufficiently close to the work, thus allowing the drill to run and so enter the work out of center.

My experience goes to prove that such work can be satisfactorily done only if the rod is fed through a hole 0.001 in. or so larger than the diameter of the rod, the bushing being made to come flush with the circumference of this hole. The drill then has no tendency to run and is bound to enter the work diametrically.

The Art of Interviewing

Why the Employment Interviewer Should Be Tactful and Diplomatic—Classifying Applicants for Employment—Human Element First Consideration in Employment Office

By A. H. Rodrick
Recorder, U. S. Naval Labor Board

THE interviewing of applicants for employment in industries has developed to such importance as to be termed an art. It has become one of the most essential and vital branches of employment management for reasons which will appear later on, and because of this, too much stress cannot be placed on such an important subject.

When an applicant presents himself at the employment department it is well for the interviewer to consider the fact that the applicant is seeking employment for one of three chief reasons: He may be out of a job at the present time and need work. If he is still employed he may be there because he is dissatisfied with his present employment or employer. If this is not the case he is there because he has heard something attractive about your firm which is lacking in the plant where he is at present employed.

Let us consider the first reason, namely, that he is out of a job and needs work. He is ignorant of the employment status of your firm and does not know whether you are increasing or decreasing your force. The only thought in his mind is that he must have work, perhaps to support a large family. Yours may be the first employment office he has entered or it may be the last; entered perhaps, in a spirit of desperation. In an age of unemployment such examples are prevalent. In a case of this kind do not forget the human element. I know that every hour of the day the interviewer is pressed for time, and when the firm is not increasing its force there prevails a tendency to get rid of an applicant as quickly as possible. In following such practice you may be doing yourself and your firm a greater injustice than you are the man who stands before you.

Creating a Good Impression For Your Firm

Listen to his story. If it is too long suggest kindly that he condense it, and when you have fixed in your mind a digest of his case, if you believe it to be a deserving one proceed to explain and advise. The explanation of the employment status can be very brief; words to the effect that at the present time you are not increasing the force but that his name will be entered on the reserve list for future consideration when the services of additional men are needed. From your present and future attitude toward him he will decide for himself whether or not that expression is stereotyped. It is up to you whether he gains the impression that you are serious or bluffing.

Do not hold before his eyes pessimistic visions of the unemployment situation—he is pessimistic enough already. Neither be so optimistic that he would feel like quoting you as an authority to his friends, thus causing a stampede of applicants at your office at a later date. It were better that you make no reference to unemployment or conjecture as to when your plant will take on additional help, but deal solely with the individual—his welfare. Before you stands a man who is experiencing, maybe for the first time, what it means to be out of work. Perhaps you have never experienced that feeling yourself. Deal with him considerately and let the milk of human kindness flow in your veins. If you know of anyone in the same city who may need help, a card, with an introduction consisting of a few words, to your fellow employment manager or interviewer will help materially in settling the troubled mind of the applicant. Such a simple act of thoughtfulness may prove the means of stabilizing his ambition to renewed effort. In acting in this manner you are gaining one more individual who can be added to your list of personal advertisers—those who advertise your firm without receiving pay for their services.

Tact Necessary With Dissatisfied Applicants

If the applicant is not out of employment then he may be seeking a position in your establishment because he is dissatisfied with his present employment or employer. In such cases the greatest degree of care should be exercised in interviewing in order to safeguard the welfare of your own organization. In practically all such cases the applicant comes harboring a feeling of dissatisfaction and he is just seeking someone to whom he can confide his resentment, not thinking of the effect it will have on you. It is always best in cases of this kind to secure a thorough statement from the applicant and learn all the facts in his case before forming an opinion. Do not create the impression that you are not in sympathy with the action he has taken in seeking employment elsewhere, for to do so may defeat the very purpose of your interview. It is very true that some men who have become dissatisfied with certain foremen and certain working conditions have in other establishments proved to be not only satisfied but energetic, successful and progressive workmen. It is wrong to take the attitude that all men who become dissatisfied once will repeat the operation. For these as well as other reasons the interviewing of an applicant who is seeking a change of employment solely because of dissatisfaction should be carefully conducted, and no detail overlooked. If after you have carried on the proper line of examination and cross-examination, you feel convinced from the statements and answers made that the applicant's desire to leave his present employer is without good foundation, the interview need not proceed further. Of course you would not employ him, because you have no assurrance that should you do so he would not later do the same thing to you that he is now doing to his present employer.

It is also well to index the name of the individual in a separate file with a digest of the facts learned for future reference to prevent employment at a later date when the force has to be increased and labor is scarce. By refusing to employ an individual of such impulsive instincts you are doing nothing more than protecting your future turnover.

But suppose from the facts narrated, together with the appearance of the applicant and the impression gained from his method of conducting himself during

the interview, you do not consider him to be a grumbler, what course should then be pursued? Having learned the real reason for his present mental state, careful thought should be given to the question whether a condition similar to the one he has told about exists in your establishment. If so, steps should be taken to rectify it. If it does not exist, the probability of its occurrence should be considered, thereby placing yourself in a better position to arrive at a satisfactory adjustment in the future. If the applicant's cause of complaint is a reasonable one, the same thing is apt to happen in your plant at any time, and it is your duty to be prepared to rectify all such conditions and to prevent, should the occasion arise, any of your employees from having cause to lay bare disagreeable conditions to some other employment manager or interviewer, all of which naturally has its effect on the good-will of your business. What has caused one man to leave his employer may cause many to leave you.

If the applicant is not seeking employment for either of the two reasons mentioned then it may be that he is desirous of connecting with your firm because he has heard of advantages to be gained by working for you; advantages not found in other establishments. This applicant is before you as a result of some personal advertising for which your firm has made no pecuniary outlay. You should make every effort to ascertain just what it is about your business that has appealed so much to this individual as to cause him to want to leave his present employer and cast lots with you. When this has been disclosed you should then find out from what source the applicant has obtained his information. If it has come from one of your employees it shows that conditions are satisfactory to your personnel, which is a valuable asset to any plant.

Should the interviewer follow out the suggestions offered it is believed that he would soon realize that successful interviewing is an art.

The Origin of the Milling Machine

Origin of Machine Obscure—Was Probably First Developed by Clock Makers in 16th Century—History of the Machine in This Country

By L. L. THWING

IIS commonly asserted with reference to inventions, that they appear in response to a definite demand. This is true in a certain limited sense. There has, for example, always existed a desire on the part of man to navigate the air and the depth of the sea, but this object was not accomplished until our mechanical assets had developed to include internal combustion engines. Steam carriages were used before rails were provided for them and were the first automobiles, but we had to wait for cheap manufacturing methods, good roads, pneumatic tires, and a wealthy civilization to support their manufacture on the present scale.

A definite device may be invented in response to a definite demand, or an "abstract" mechanism may be adapted to a concrete purpose. Alchemy and perpetual motion have occupied the time of many men with no direct results, but the byproducts have been the science of chemistry and many mechanical details which have been effectively adapted to other uses. Differential gearing was contrived and built to gain power, but proved to be only an absorber of it. It was a secret for over twenty years, from which its inventor received neither profit nor credit. Others re-invented it and received both.

That we should have a complete history of the development of any important mechanism that is more than one generation old, is extremely unlikely. Even in our own time we do not agree upon any one man as the inventor of the electric motor, the automobile, or the airplane. Suits for infringement of patents are abundant and even in the drafting room there is dispute as to who contributed the most to the design of a new machine. When we attempt to investigate the history of such an old device as a lathe we are fortunate if we can trace the steps in its development and assign to them approximate dates. We do not know the name of the man who built the first lathe, and it is highly improbable that we will ever know the name of the inventor of many of our most common mechanisms.

In view of these uncertainties it is not surprising that we are not agreed upon the inventor of the milling machine. We may assume, however, that the first man who conceived the idea of a rotary cutter was the inventor. He may not have made such a cutter, but he must have pictured in his mind some sort of mechanism to support and rotate it.

The first inventor and mechanical engineer who left any considerable record of his ideas and inventions, was Leonardo Da Vinci, born in 1454. His reputation as an artist is well known and if his record as an engineer is less so it is because engineering is a less popular subject and one whose tangible results cannot always be associated with the engineer's name. Da Vinci did, however, leave behind him a number of sketch books in which he was accustomed to record ideas, in the form of freehand sketches, that are remarkable when we consider the period in which he lived.

It would have been impossible in his day to build some of the machines which he suggests, but many of them have been re-invented, and are parts of our best engineering practice. Among other things are sketches of a lathe with a carriage driven by two screws and equipped with change gears for screw cutting. There are boring machines, sawing machines, universal chucks, and many other devices; but nothing suggesting the use of a rotary cutter. There are reciprocating saws, but no circular saws. If Da Vinci knew, or ever thought of the possible use, of a revolving cutter other than a drill he left no record of it.

If on this account we conclude that milling machines were the product of a later period, when is the earliest following date at which we might expect to find some evidence that they were used? It will be the next period whose manufacturing processes felt the need of the milling cutter. If it had happened that Da Vinci's books contained a sketch of a milling cutter, this would not mean that he had ever built one, as there was no demand for it in the fifteenth century.

As shown in H. H. Manchester's interesting articles in the *American Machinist*, there was an astonishing amount of ingenuity shown in the middle ages in the construction of various machines and mechanical contrivances. Strength however was the principal requirement. Accuracy, quiet running and finish were minor considerations. If a machine actually worked when turned slowly by hand, it was of small moment how much it rattled, rumbled or squeaked. The old "mill gearing" could be heard a mile away.

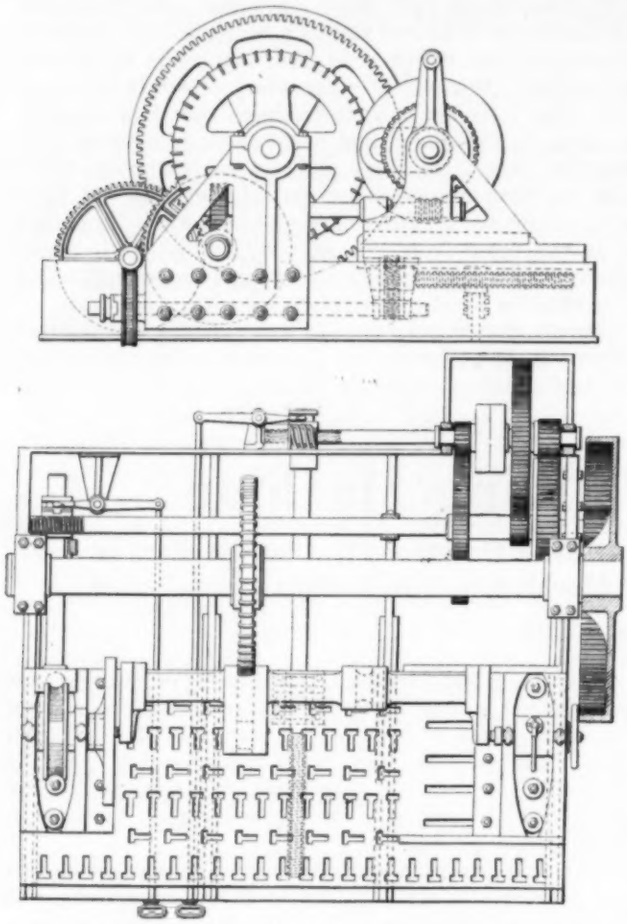


FIG. 1. CRANK MILLING MACHINE BUILT IN ENGLAND ABOUT 1845

In a few trades however the demand for accuracy was greater. Gunmakers, lockmakers and clockmakers required smoother working parts, and as these parts were small and could be turned on the pole lathes of that period, or, if irregular, could be filed out, the chance for securing this accuracy was more favorable than in the case of, say, a cannon boring machine.

Of these trades the clockmaker demanded the greatest accuracy and his product had the greatest number of duplicate parts. (I do not know how many teeth there were in one of the seventeenth century clocks, but there were a good many more than I should want to file out by hand.) The science and art of clockmaking had advanced considerably by 1650; different methods of escapement were discussed, and Dr. Robert Hooke, who is known to us as the inventor of the universal joint, is known to the watchmakers as the inventor of the balance wheel and the anchor escapement. Hooke has also been mentioned as one of the possible inventors of the milling cutter.

It is also true that gunmakers and lockmakers required many irregular shapes that were later responsible for the development of the milling machine in this country, but in their case the parts were larger and the average workman, then as now, could file out a better gunlock than he could a clock gear. Whether or not clockmakers did invent and use milling cutters we do not know, but it seems their need for them was pressing, and, furthermore, conditions were favorable.

Clockmakers were skilled mechanics, and the size and nature of the materials they used demanded little in the way of strength or rigidity. They were accustomed to the use of the lathe and files, and they sharpened their tools on grindstones. In an article on early methods in clockmaking the following method of making gears is mentioned: "by using a cutter revolving at 3,000 to 4,000 r.p.m., shavings come off like fine dust." This suggests a cutter with very fine teeth—in other words a rotary file.

In this connection it will be remembered that the French name for a milling machine is *machine á fraiser;* literally a "strawberrying machine." The roughened surface of a strawberry suggests a rotary file, and it often happpens that new devices are given names suggested by their similarity in appearance to familiar objects.

In the English edition of "Appleton's Encyclopedia," is found the following quotation from Dr. Robert J. Hooke, who was born in 1656. I have not been able to verify this quotation from any original source. Discussing the formation of a primitive helical gear, made by building up a number of thin gears he says "And this is always to be observed in the *cutting* of the teeth. The end of one sloped tooth on the one side, be full as forward as the thickness of the next tooth on the other side." The use of the word "cutting" is significant as it indicates that the gears were not cast or filed. They may have been milled out or cut out by some sort of a primitive shaper, or even punched out under favorable conditions.

Lastly, in 1867 the editor of the *American Artizan*, which was I believe the immediate predecessor of the *American Machinist*, in an article on milling machines says: "The original milling machine was a rotary file. It was used in the poppet head of a lathe, and a traverse carriage was attached to the wooden bedplates. It originated in gun shops, and was next used by sewing machine companies."

I do not know the date or authenticity of the quoted use of the milling cutter for clock gears, some French etymologist may upset the (not original) derivation of *"machine á fraiser,"* and it is quite possible that editors of the Civil War period were not as well informed as they are today; but these things constitute the circumstantial evidence in the case, and when on the other hand, we offer as direct evidence the statement of some man who lived over two hundred years ago, as proof of any claims, we are quoting someone whose reputation for knowledge and veracity is unknown to us.

It is, therefore, at least a plausible conjecture that milling cutters were used at least as early as the year 1700, and that the inventor was a clockmaker. The date 1700 is assumed because Noxon's "Mechanical Exercises" is quoted as having mentioned milling machines; circular saws are said to have been invented in Holland in the sixteenth century; and lastly, because there is a milling cutter said to have been owned by Jaques de Vaucasson, who died in 1784, and which is now in the possession of Brown & Sharpe.

If milling cutters were developed from rotary files it must have taken some years to accomplish that feat. It is conceivable that a man who had a grindstone, a file, and a lot of clock teeth to form, might have connected the rotary idea of the stone with the cutting action of the file and produced the first milling cutter, which, fixed in the poppet head of his lathe, constituted the first milling machine.

The earliest authenticated date for the use of the milling cutter is 1815. By this is meant that the evidence is not the printed repetition of hearsay. The book from which the illustrations of the two gear cutting machines are taken is from a collection of papers published by a prominent engineer in 1822, and the particular paper on gears was written in 1815. It is worthy of note however that the author does not consider milling cutters anyting of a novelty; which indicates that they were in use some years before 1815.

In 1885 the use of the milling machine had reached the point where it was a matter of discussion before the English Institute of Mechanical Engineers. The oldest milling machine known to any one of those present was a crank milling machine, said to have been built and operated in 1845. This machine is shown in Fig. 1, and the cut and description is taken from the *Practical Mechanics Journal*, Glasgow, 1848, as follows: "This may be described as a triplicate machine, including the lathe, the planing machine, and the cutting or boring machine. The specific employment of this machine is for finishing the crank arms of locomotive axles. On the cutter bar *C* is fitted a cast-iron disk with a series of cast-steel cutters *E* accurately formed to the curvature of the finished crank neck. By the arrangement of gearing, the cutters are caused to move at the rate of 28 ft. per minute . . . The weight of the complete

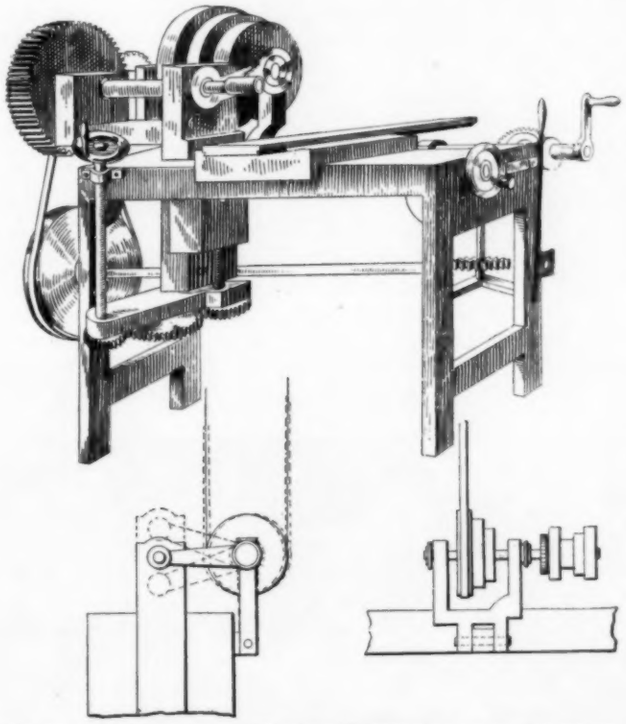


FIG. 2. MILLING MACHINE PATENTED BY W. H. ROBERTSON OF CONNECTICUT, IN 1852

machine is 7 tons, and it completes one crank block of 12-in. radius in 9½ hours."

This description is of additional interest on account of the use of inserted tooth milling cutters; the first of which we have any mention.

The history of milling machines in this country is briefly as follows: What was probably the first milling machine was built in 1818 by Robert Johnson, a gunmaker who settled in Middletown, Conn., in 1814. Johnson did not claim this to be his invention. Two others are also mentioned as pioneers: Robbins & Lawrence of Winsor, Vt., who are mentioned as having used a milling cutter in the lathe spindle and later developed a milling machine, a cut of which appeared on page 291, Vol. 32, of *American Machinist* showing nameplate and the serial number No. 21; and the Eli Whitney milling machine, now in the Mechanical Engineering Museum at Yale. This latter was built some time after 1815 and possibly as late as 1830.

There is no definite evidence at this time that any one of the above men is entitled to the credit of building the first milling machine in America. It is possible that the two last mentioned may have re-invented it without knowing that it had been used elsewhere at an earlier date. News travelled slowly in those days and Johnson may have had a milling machine in operation for years without its coming to the knowledge of Robbins & Lawrence.

The well known Lincoln miller takes its name from Levi Lincoln of the old Phoenix Iron Works, and a strong claim may be made for him as the inventor of this machine, about 1834. Francis Pratt, however, is generally mentioned as the designer of this machine, about 1855.

The first patent on a milling machine issued in this country was to W. H. Robertson, of Hartford, Conn., in 1852. This is shown in Fig. 2. It is not known that any machines were built after this model, but it shows an attempt to adapt a lathe for milling. It is essentially a Lincoln miller without the arbor support, unless the different method of raising and lowering the arbor would exclude it from that classification.

Wood & Light built millers in 1851, and the New Haven Manufacturing Co. at least as early as 1860. At this time there were several lines of development, the column and knee type of Eli Whitney and Robbins & Lawrence; the Lincoln type; Index Milling Machines; and shortly afterwards Brown & Sharpe's universal machine.

The Brainerd machine was the design of A. H. Brainerd, of the Union Vise Co., 61 Water St., Boston, and was first advertised in the *Industrial Monthly* in 1872. The Lipe (Syracuse) Universal, first advertised in 1882, had many features of design which were in advance of its time. The swivel plate was of large diameter; the index heads were more like later models; and the weight, 2,800 pounds, was heavy for its capacity. The design of the drive was unusual, and was discontinued by the later manufacturers of the machine.

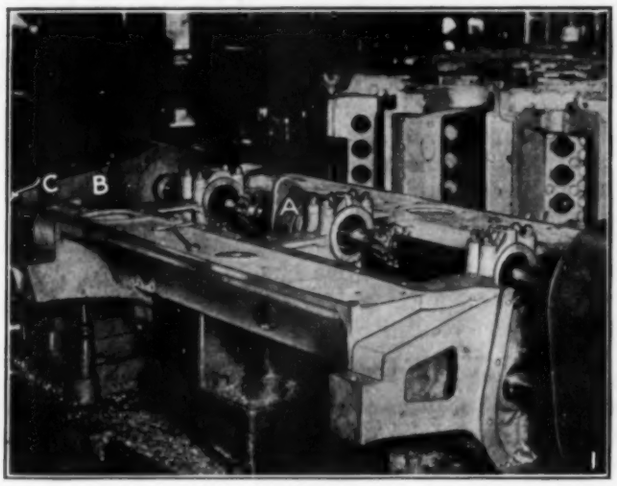
Even as late as 1882, milling machines were not common in machine shops, and were hardly used at all as an improvement on the planer. There is a discusion in the proceedings of the A.S.M.E., Vol. IX, led by J. J. Grant, which shows this very plainly. Since that time the development of the milling machine is familiar to most of us. The all gear feeds and speeds machine is about 20 years old now. The Lincoln millers, which seemed to be losing ground, regained it rapidly during the late war. Today continuous milling, automatic milling, and the question of additional overarm support seem to hold the center of the stage.

Details of Crankcase Work

Different Types of Reaming Fixtures—"Hand" Reaming by Pneumatic Motor—Running in Crankshaft Bearings by Power—Roller Conveyors as Labor Savers

SPECIAL CORRESPONDENCE

THE accompanying illustrations show the practice followed in crankcase boring by three different shops. Fig. 1 shows a crankcase of a Packard twin-six where the main bearings as well as the camshaft bearings are being bored on a special horizontal boring machine. This view shows the central support at *A* for steadying the boring bar and the arm *B* which carries a tool for facing the transmission end of the crankcase. The facing head has a star feed, the wheel being shown at *C*.



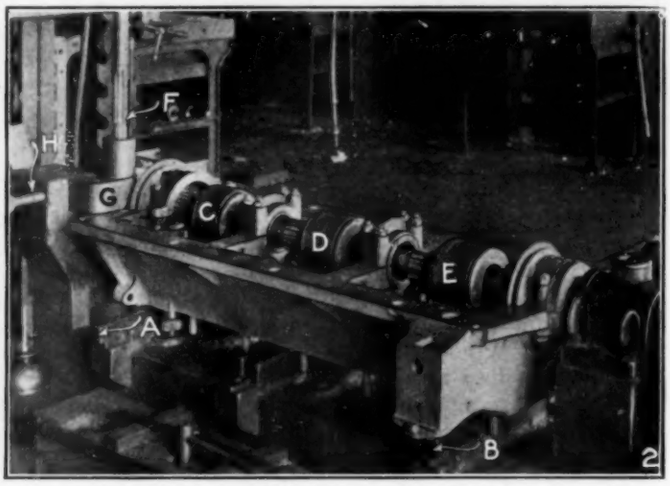


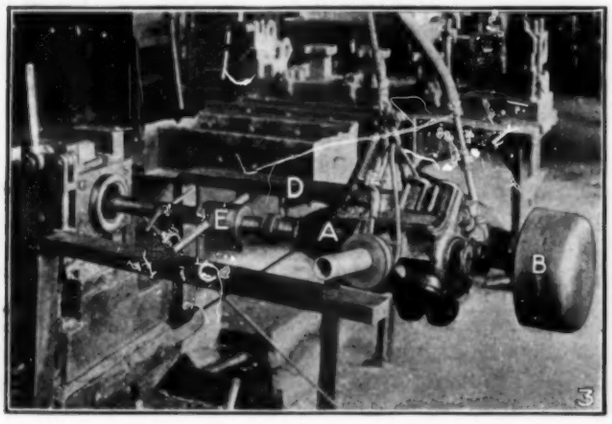
FIG. 1. BORING PACKARD MAIN BEARINGS. FIG. 2. THE STUDEBAKER METHOD

Reaming the Studebaker crankcase is shown in Fig. 2, the fixture having a number of interesting features. The crankcase is carefully supported on parallels as at *A* and *B*, the boring and reaming bars being substantially guided by the three bearings *C*, *D* and *E*. Reaming one of the vertical holes is shown at *F*. The reamer is guided by the block *G* which is held in position by the pin *H* but can be readily swung up out of the way for removing the crankcase from the fixture. This "hand" reaming operation is in reality performed by a pneumatic drill suspended by counterweights and free to move in any direction so as to remove any tendency of the reamer being forced to one side or the other.

Fig. 3 shows the outer end of the reaming fixture with the air motor which drives the reaming bar. This operation is also in effect one of hand reaming in which the power is supplied by the air motor shown at *A*. The large wooden block on the end *B* enables the operator to easily move the whole bar and motor forward by pressing against the block. The ease with which the air motor can float can be judged by the manner in which it is suspended. The bars *C* and *D* serve to support the handles of the motor and prevent it from turning. The form of quick coupling used is shown at *E*.

The crankshaft bearings of the Studebaker motor are run in on the stands shown in Fig. 4. Here the crankcase is held in place by the clamps shown, the crankshaft being driven by the pin type of flexible coupling at *A*. This coupling is moved in or out of contact by the lever *B*, making it also act as a clutch. The electric motor is in the box *C*, at the left.

After the crankcase is in place it is covered by a



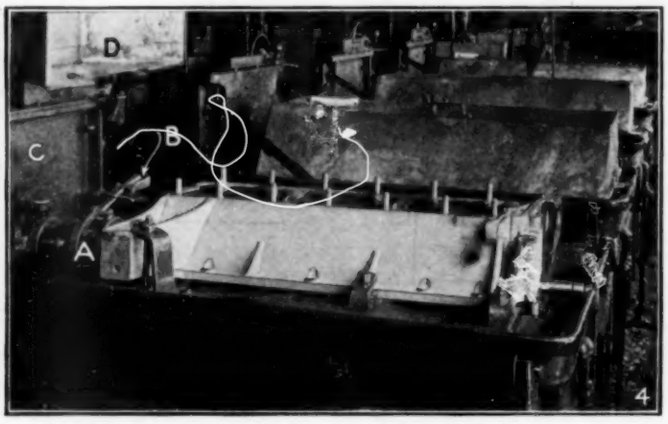


FIG. 3. HAND REAMING WITH AIR. FIG. 4. RUNNING IN THE CRANKSHAFT

pan, as shown on the other stands which are behind. These pans can be lifted up out of the way as at *D*. Oil is piped into the base of the stand so as to insure thorough lubrication.

The Essex shop uses a double-headed Baush horizontal drilling machine for boring and reaming as shown in Fig. 5. The crankcase is held in a substantial fixture provided with suitable clamps and guides for the boring bars and reamers.

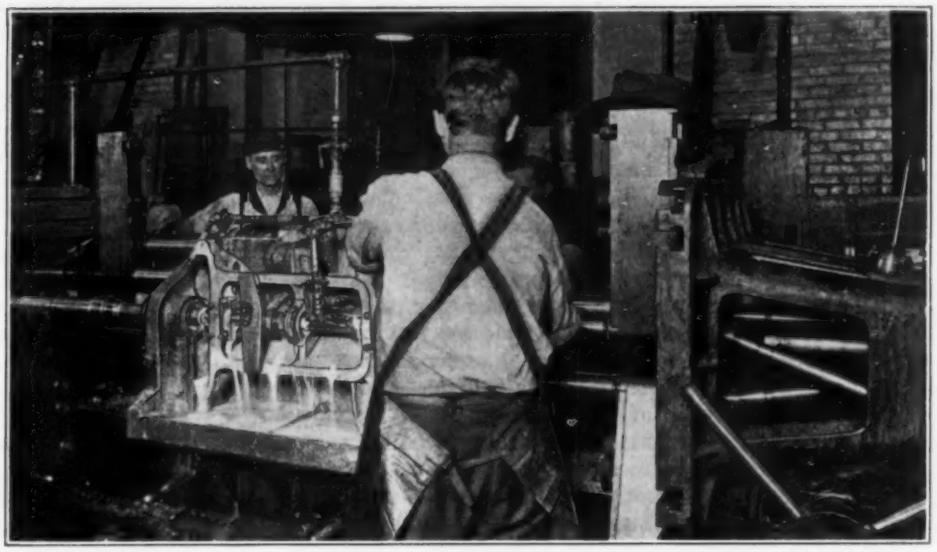


FIG. 5. BORING THE ESSEX CRANKCASE

Although not the boring of crankcases, the illustrations in Figs. 6 and 7 show final operations on engine bases in the Oakland plant. Fig. 6 shows the extensive use of roller conveyors by means of which the castings are very easily moved from one machine to the next. Fig. 7 shows a little different type of roller conveyor which has narrow rollers on each side, leaving an open

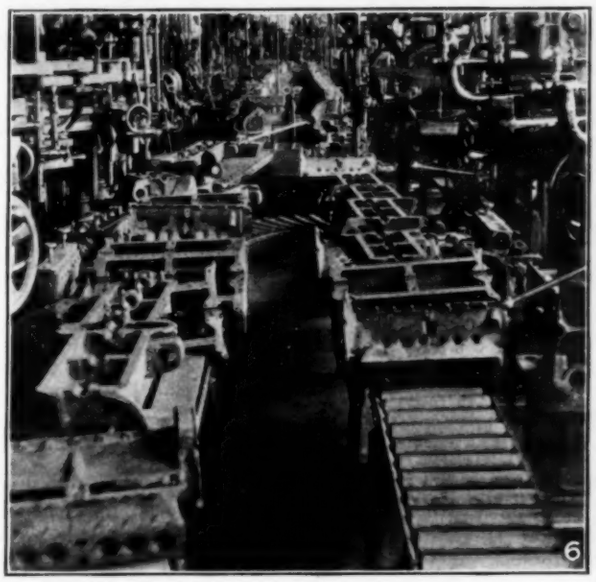


FIG. 6. IN THE OAKLAND SHOP.

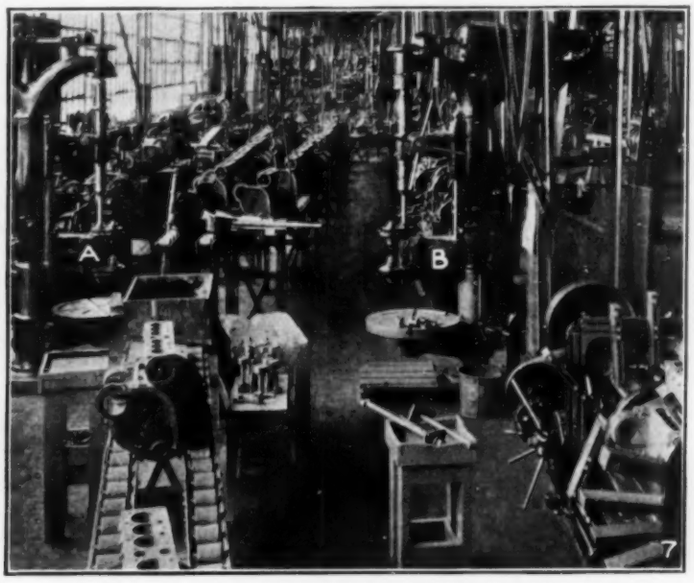


FIG. 7. ON THE WAY TO ASSEMBLY

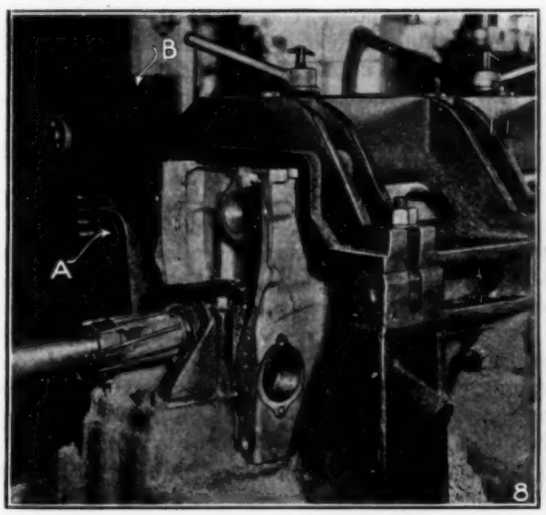


FIG. 8. REAMING CADILLAC BEARINGS.

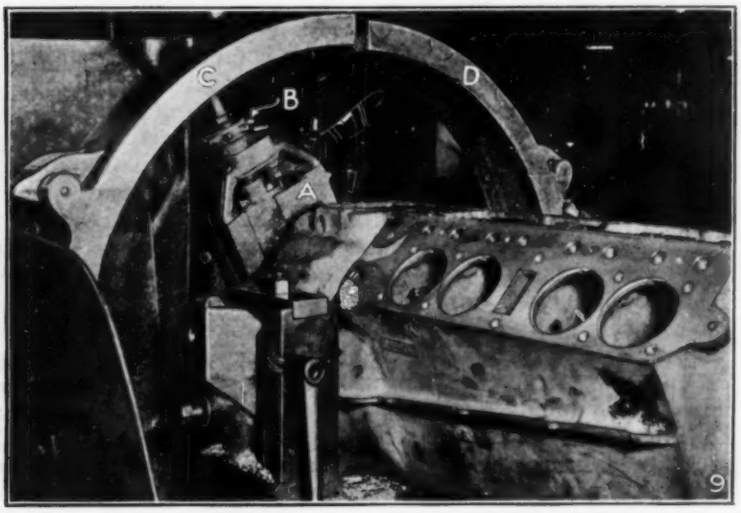


FIG. 9. FACING THE CRANKCASE

space in the center. This view also shows, in the lower right-hand corner, a horizontal boring machine with multiple spindles as well as special countersinking attachments on two of the drilling machines at *A* and *B*.

Two operations on a 90-deg. eight-cylinder motor at the Cadillac Shop are shown in Figs. 8 and 9. The end of the fixture, Fig. 8, shows its substantial construction and the way in which the upper part is fastened in position. It will be noted that the fixture is hinged at *A* and that a counterweight is provided at *B* so as to make it an easy matter for the operator to swing the upper portion out of the way as soon as it is necessary to remove the crankcase. This view also shows the reaming of the main bearings and gives some idea of the type of reamer used.

In Fig. 9 the end of the crankcase is being faced square with the bore by means of the facing head shown at *A* with the star feed at *B*. This method insures the end of the crankcase being faced square for the attachment of the transmission which is an important point.

The guard over the revolving facing head is also of interest, this being a channel-shaped casting which has the two pieces *C* and *D* hinged so as to be easily swung out of the way, avoiding all likelihood of accidents from anyone being caught as the facing head revolves.

Queries on Spindles and Bearings

By E. A. DIXIE

The inquiry under the above caption on page 466 of the *American Machinist*, will probably bring out much interesting data on the subject of lathe spindles and their bearings, a great deal of which will be contradictory.

We all have our favorite methods and materials of construction, but every once in a while one of our pet materials falls down on the job or one of our sure shot methods goes wrong, and on investigation we find that materials and methods, much like human beings, are apt to be influenced by environment. The conditions under which we learned to love and respect them were just as much responsible for their good behavior as were the inherent qualities of goodness and reliability which they were supposed to have possessed.

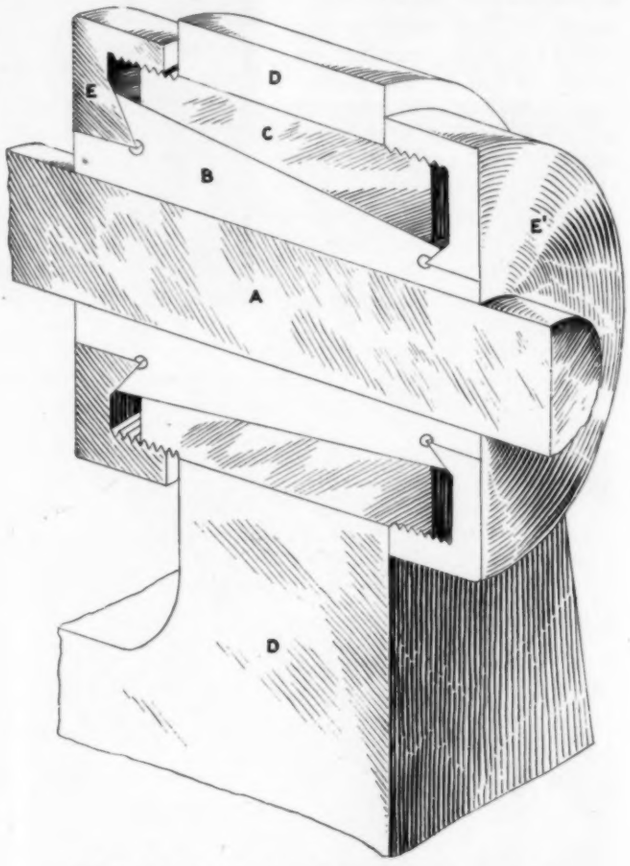
"What Form of Bearing Is the Best?"

I believe that the very best bearings for a lathe are two straight bearings in tapered shells. I do not refer to the usual type of tapered bearing shell with a thread on each end, carrying two flat faced nuts which merely determine its longitudinal position in its tapered seat. That kind of a bearing shell will not remain round when adjusted to take up its own wear and that of the journal. I *do* refer to the tapered bearing shell similar to the one shown in the illustration herewith. The main casting or lathe head *D* is bored for a forced fit for the sleeve *C*, which is machined all over before it is forced into the casting *D*. The bearing shell *B* has the usual grooves in it to permit contraction. At the ends it is provided with angular recesses. Projections of similar shape on the nuts *E* and *E*^{1} engage in these recesses and keep the shell *B* expanded against its seat in the sleeve *C*. When this shell is *closed* by the nuts to adjust for wear, it is also *expanded* by them so that it has a full bearing in its conical seat and is therefore kept round. The main objection to all bearings of this type, however, is their excessive cost.

The next best bearing for a lathe is the plain straight split box type. These are not difficult to fit, are easy to strip and align in case of wear and are apt to wear approximately round.

Comparative Wear of Hard and Soft Spindles

Hardened and ground spindles, if properly cared for, will greatly outwear soft ones. Soft *turned* spindles are not round to begin with, consequently they give poor service for lathe spindles. Besides this, size for size, a



BEST FORM OF LATHE SPINDLE BEARING

hardened spindle is much stiffer than a soft one and stiffness in a lathe spindle is of the greatest importance.

Seldom is good honest work alone the cause of lathe spindle wear. Wear is generally caused either by grit which gets into the bearings or because they are allowed to get dry and the journal either "bugs up" or seizes. Once this happens, the spindle is likely to continue giving trouble until it is taken out and refinished. When dirt gets in, it usually imbeds itself in whichever member is the softer, that is if the spindle is softer than the bearing, the grit will charge into the spindle and the bearing will suffer the most wear. The reverse would be the case if the spindle is the harder.

Babbitt Bearings for Lathes

Properly fitted babbitt bearings give very satisfactory service in ordinary lathes but they would give poor service in a jump lathe. Babbitt is of little service where there is impact or shock, as for instance in the connecting rod or crankshaft bearings for internal combustion engines, unless there is a system of forced lubrication which keeps a film of lubricating oil all over the bearing surfaces at all times.

Babbitt bearings should be carefully run-in when new. When this is done, a glaze forms on the surface which is almost file hard and will resist wear to a high degree.

The interrogator asks "What is the best bearing mixture and what is the best way of applying it?" He probably had babbitt in mind when he formulated this question but as he was not specific, I will let him in on a secret.

The best bearing mixture is made from those gray irons which will give a *close-grained, somewhat hard casting.* The best way to apply it is to machine it a close fit for the headstock and bore it with a single pointed tool and a fine feed, or better still, grind it. Cut liberal oil grooves or make it of the ring or chain oiling type. After the spindle has been fitted, set the head up and run the spindle in. Use plenty of oil and keep a close watch on the bearings for several days. Open the bearings every few hours and inspect them carefully. After a while a "skin" will form on their surfaces. Once this "skin" has formed the bearing will run for all time if kept properly lubricated and clean.

The above reminds me of a trip I once made through the factory where they manufacture what I consider to be the best lathe in the world. While wandering alone in the shop, the designer of this great lathe came up and introduced himself. We were talking general shop matters when suddenly he shot at me:

"What is the best bearing metal for a machine?"

"That" said I, "is rather a big order to come so suddenly, but let us put it this way: Suppose I had to make bearings for all kinds of machines and was compelled to choose a single material from which to make them, then I would say good *close grained cast iron,* but if I had to sell the machines after they were built, *I would brass-plate the bearings where they were visible.*"

The designer threw back his head and laughed heartily. "That's just what we do, we make our bearings of . . . metal, but people are so stuck on bronze that we are compelled to put a brass cap on the bearing where it shows."

The only thing the matter with cast iron is its low price. Bearings made from it will usually give better service than those made from any other metal, but it is cheap and the customer thinks you are trying to skimp on material. So if you use it, *brass-plate it where it shows.*

After babbitt is cast into the bearings it should be condensed by rolling with a tool similar to a tube expander or by hammering with a pneumatic hammer or by hand. The bearing should then be bored slightly under size with a single pointed tool, then a button broach should be pushed through it. If an accurate fixture is used to guide the button broach the hole will not require correcting. If no fixture is used, the bearing will probably require scraping, which is poor practice but must be resorted to in aligning the bearings.

Carbon content has no effect on the running qualities of a steel shaft in a bronze bearing. A low-carbon steel shaft will run at ordinary lathe speeds just as satisfactorily as one made from a high carbon steel, but, other factors being equal, a high-carbon steel shaft running in a clean, well lubricated bronze bearing will show less wear than one of low-carbon steel.

A Profitable Business for the Machinist

BY DONALD A. HAMPSON

To the machinist who is tired of working for wages the automobile field seems to offer endless opportunity; and if he be a thorough mechanic who can surround himself with conscientious helpers, he cannot help but succeed in the repair field. Then there is the garage business in general, the gas-and-oil station, the selling of cars, storage battery work, radiator repairing, and tire mending; lines that can be specialized in and for which the machinist is as well qualified as any other man without business training.

There is another branch of the auto business which is singularly adapted to the machinist's previous training and in which there is almost no competition; cylinder regrinding. It is an acknowledged fact that grinding is the best way to finish cylinder bores, while it stands alone as the proper method of enlarging and truing up worn or scored cylinders. The speed with which the work may be done, the perfection of finish, the ability to remove a minimum amount of iron or to dress down a hard spot; all these things, and more, are points in favor of the grinding method of renovating used cylinders.

Now the mechanic who goes into the auto business generally hunts around to find a second-hand lathe, a drill press, a grinding machine or two, and maybe a shaper. These, with shafting and small tools and work benches, constitute his shop, which usually is located in the rear of some dark building whose front is reserved for car storage space. He knows that gas and oil sales will pay his rent, so he puts in the tanks and a supply of these liquids. By that time he has spent $5,000 for the equipment of an establishment that he thought would stand him in not over a thousand.

On the other hand, suppose the machinist puts all his money into one machine; a cylinder grinding machine that is absolutely first-class and the most efficient tool for the business. He spends an amount not over half of his $5,000 and he gets in return a machine complete with motor, emery wheels and fixtures all ready to run. A workbench with vise and a few tools are all else needed before opening the doors for business.

Such a business may well be conducted in a store on the main street of any town. It will draw trade and be a valuable asset to any community. With the machine placed in or near the front window the work is carried on in the best lighted space available and moreover it is carried on where it is a constant advertisement of the business. Any moving display attracts attention, while one so novel and touching a commodity so widely used, doubly attracts.

The owner of a car or a fleet of trucks knows that the average garage man would not install so complicated a machine as the cylinder grinder appears to be, nor would he be competent to operate it if he did happen to have one about. He knows that heretofore it has been necessary to send a cylinder block a long distance to the nearest big city to get the bore put in shape; waiting perhaps weeks for its return, or else he had to half-do the job by putting over-size pistons and rings in cylinders that were out of round or scored.

The man who has the initiative to go into the cylinder regrinding business right can make the same charges that are made in the big cities.

In all communities Fords predominate. Then, usually, there are one or two other cars that have been sold largely; such as, say, Buicks and Overlands. These three makes will include about a dozen designs or sizes of pistons. A stock of pistons for these in 0.005 and 0.010 in. oversizes would cost about as much as the garage man's stock of gas, oil and grease and the customer who is in a genuine hurry will always pay well for such foresight.

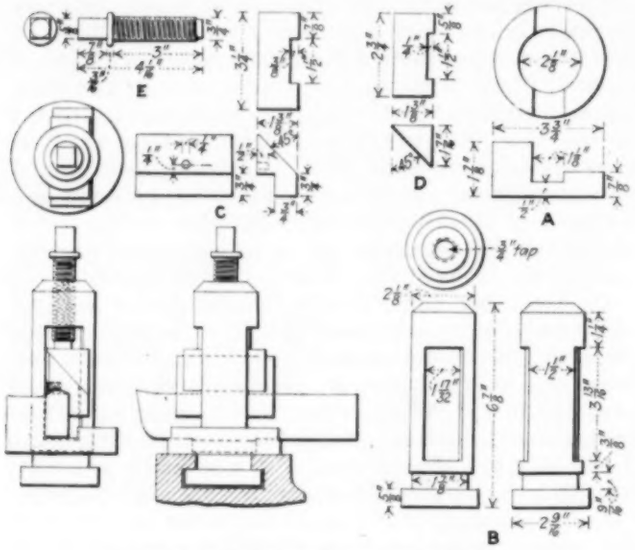
Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

An Improved Single-Screw Toolpost for the Lathe

By MARTIN H. BALL

The accompanying sketch shows a way of holding an ordinary lathe tool more rigidly to position on the toolblock with a single screw and with the minimum



IMPROVED FORM OF TOOLPOST

amount of alterations from the toolpost as most commonly made. I believe, as A. L. De Leeuw states in his article on "Metal Cutting Tools," page 168 of the *American Machinist*, that the use of the common form has become a matter of habit and is hard to get away from.

Most lathe operators have experienced trouble occasioned by the tool swinging round, the center of the setscrew acting as a pivot. It is not difficult to understand why such action occurs, as ordinarily the tool has no side support. Even when it is carefully set in the regular toolpost with a side bearing against the post, this point of bearing is so close to the pivoting point that its value is very limited.

In the improved type the lower side bearing is placed on the side that must bear the thrust of the cut while the upper side bearing is on the opposite side of the tool; always forcing the tool over until it gets a solid bearing in the direction of the side thrust. These side bearings extend along the length of the tool to about the extent of the ordinary toolpost bottom bearing, which is the diameter of the toolpost ring, or leveling plate.

The assembled view shows the general construction of an improved form of toolpost to be used on a standard 24-in. lathe. The ring *A* has a slot across the top, placed centrally and of a width that prevents the tool from having a bearing on the post *B*. A high portion on one side of the slot affords a substantial side support. *C* is the clamping member, with its upper surface made at an angle corresponding with the lower surface of the cap shown at *D*.

The setscrew *E* is standard and finds its seat on the cap, forcing the cap against the side of the post, and the cap in turn forces the clamp *C* against the top and side of the tool simultaneously. The cap and clamp are prevented from falling out of place when the tool is removed by a small spring plunger inserted in the side of the clamp and bearing against the slot in the post.

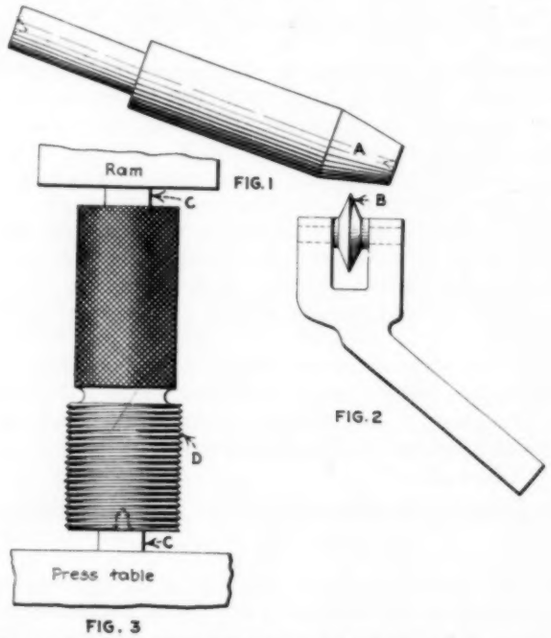
These members can be assembled or removed when the setscrew point is flush with the top of the slot in the post.

Increasing the Diameter of Work Before and After Threading

BY E. A. DIXIE

Two rather interesting jobs have recently gone through the shop. By a peculiar coincidence they were both threading jobs and both had been made too small. In the one case the work was soft and in the other it was hard so that dissimilar expedients were resorted to in order to make corrections and save the work.

In the first instance about 50 spindles had been turned as shown in Fig. 1, the tapered end *A* to be threaded 12 threads per inch. Owing to a mistake on the part of the lathe hand the tapered ends were all turned about 0.01 in. too small.



FIGS. 1 AND 2. EXPANDING A SOFT THREAD. FIG. 3. EXPANDING A HARDENED THREAD

The threading was to be done on a lathe with a taper attachment and not until the first spindle had been threaded, and spoiled, was it discovered that the tapered part was too small in diameter to permit a full thread to be cut. However, the lathe hand who had the threading to do was a resourceful cuss so when he found that he had too little stock he proceeded to devise a method of putting some on where required.

In his kit was the knurl holder shown in Fig. 2, and for use in this he made the V-shaped roller B. This roller was of tool steel hardened and ground to correct shape for 12-pitch U. S. S. thread.

The tapered ends of the spindles were first threaded in the usual manner but not quite to full depth. The threading tool was then replaced by the thread-rolling outfit shown in Fig. 2, and the threads rolled to correct depth, The metal left at the bottom of the thread was displaced by the roller which caused it to flow up each flank toward the top. This increased the diameter of the threaded portion the desired amount. The resultant thread was accurate to size and had a highly burnished surface.

The other job was incidental to the making of a thread-gage.

This gage was an ordinary plug thread-gage 1¼ in. in diameter. It was made of machine steel carborized to a depth of about ⅛ in. After grinding the hardened thread a cast-iron lap was made and lapping proceeded with. Owing to some misadventure during the lapping operation the gage was lapped nearly a quarter of a thousandth too small.

The toolmaker on discovering his mistake made two hardened steel disks *C*, as shown in Fig. 3. One of these was placed under the end of the threaded portion of the gage *D*, and the other on top of the other end. A small teat at the center of each of the disks, entering the center holes in the ends of the gage, served to center the disks with relation to it. This assembly was placed under the ram of an hydraulic press and a pressure of about 10 tons applied. After the pressure was taken off the thread diameter was measured and found to have increased about 0.0002 in. Pressure of 20 tons was then applied and on measuring it was found that the gage had expanded nearly half a thousandth, which was more than enough to allow for finish lapping. Careful examination and measurement of the threaded portion failed to show change of any sort other than radial expansion. What apparently happend was that the ⅛ in. of "case" on the ends of the gage collapsed under the 20 tons of pressure, the unhardened steel of the core being pressed from both ends was compelled to expand, thus increasing the diameter of the gage.

Two Automatic Milling Machines

BY FRANK R. SHAW

The two machines described in this article were developed during the war for the manufacture of brass firing pins for use in the fuse of the French 75-mm. shell. While the machines are comparatively simple, the principles involved are somewhat unusual and may prove of interest and benefit.

The raw material was supplied as extruded brass bars of the shape shown in Fig. 1, and the finished article is shown in Fig. 2. It was necessary that the bars should have the upper part beveled on the two sides and grooved on the top lengthwise of the bar as shown at *A* and the same operation was to be performed crosswise of the bar on each piece before they were cut off.

The first operation was done by the machine shown in Fig. 3. A formed milling cutter was used, but the

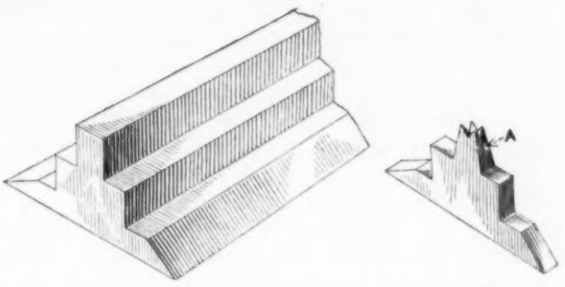


FIG. 1. BRASS BAR STOCK. FIG. 2. FINISHED PIECE, BRASS FIRING PIN

usual process of clamping the work to a moving table which would have required returning the table and reclamping several times on each bar was discarded

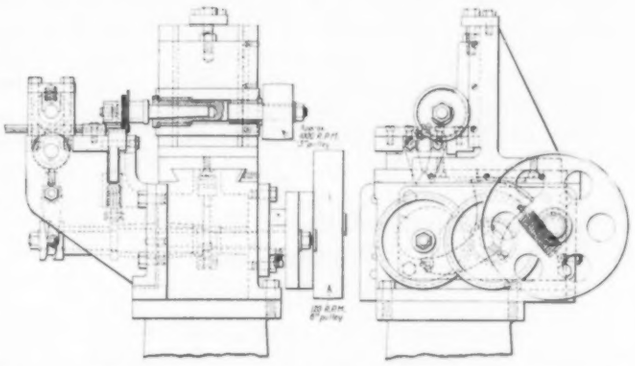


FIG. 3. MACHINE FOR BEVELING SIDES AND GROOVING TOP OF BAR LENGTHWISE

and the bars were fed continuously to the cutter by a pair of rolls under spring tension, the rolls bearing on the lower flange of the bar. A pair of guides were placed as close to the cutter as possible, as shown, and

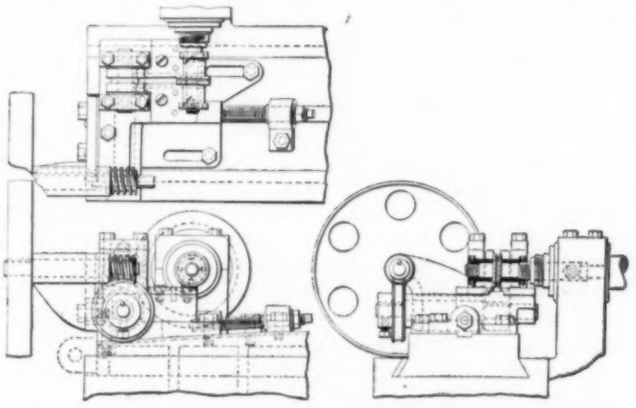


FIG. 4. MACHINE ON WHICH SAME OPERATION WAS PERFORMED CROSSWISE OF BAR

the cutter head was mounted on an inclined base, with a tongue, adjusting screw and clamp screws to get adjustment for height. The only difficulty experienced was that at first the bars were allowed to slide along the bench, developing friction enough to retard the feed. A few wooden rollers were mounted along the bench under the bars after which there was no further difficulty. The machine ran continuously with very little attention; only requiring the bars to be

started and the cutters to be sharpened occasionally.

The second operation was done by the machine shown in Fig. 4. The machine consisted of a base carrying a camshaft driven through a train of gears by a pulley at the end. On the top of the base was a bracket carrying a cutter spindle which was driven by another pulley. A vertical slide allowed adjustment for height of the cutters and the spindle traveled horizontally along a slide on the top of the base, this movement being produced through a segment with lever and cam from the shaft through the base. The lever was held against the cam by the spring inside the base. The bars were fed to the cutters by a pair of rolls as in the first machine, the rolls, however, being driven by a ratchet and pawl operated from a cam on the camshaft, thus securing the intermittent motion required.

In front of the rolls was mounted a pair of guides and between these and the cutters a pair of clamps operated by a wedge forced up between the lower ends by another cam. It will be seen that the cutters consist of a formed cutter for beveling and grooving the point and a saw mounted in the proper location for cutting off the pins. An adjustable stop was set into the front bearing of the spindle head to insure the pieces being cut off at the proper thickness.

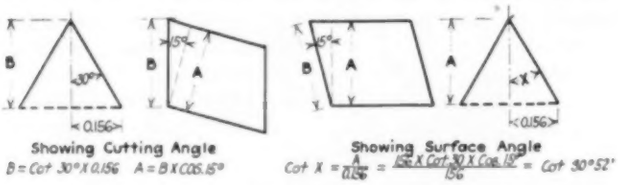
The machine did very satisfactory work and produced the pins at the rate of about 1,500 per hour.

Development of the Cutting Angle of V-Thread Tools

By JOHN H. MAGUIRE

The sketch shows the development of the cutting angle of a V-thread tool to the surface angle or the angle to which the tool is ground in order to have the proper form and clearance.

It is my experience that, though the shopman can get the proper form of thread, there are very few who have given the matter of grinding tools the proper


B
30°
0.156
Showing Cutting Angle
B = Cot 30° X 0.156 A = B X COS. 15°
15°
A
X
Showing Surface Angle
Cot X = A/0.156 = 156 X Cot 30 X Cos. 15° / 156 = Cot 30°52'

DEVELOPMENT OF ANGLE OF THREAD TOOL

attention. When a tool is ground with the right clearance and surface angles it retains its form for a much longer time than otherwise.

This diagram is the only thing I have ever seen that is simple enough to appeal to the average toolmaker as worth bothering with.

Though I have used the V-form in my example, the formula can be applied to any form of tool, it being necessary to substitute other values for the angles and given dimension. I use the V because it is the most commonly used. I have shown it to many toolmakers and all have commented on its being clear, and have invariably requested a copy.

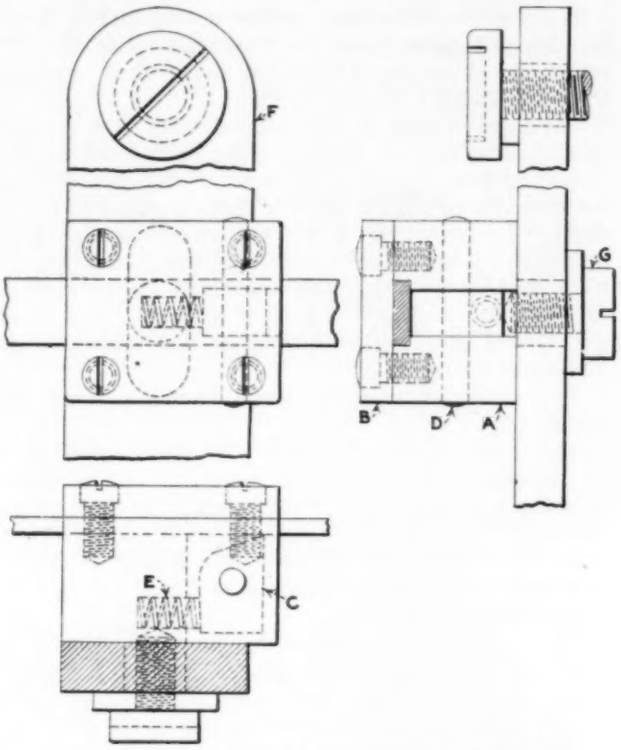
Feeding Device for Press Tools

By JOSEF RASK

It frequently happens when a die is designed and made, that the means for feeding the stock into it is neglected or omitted. It is usually left to the press-hand, to look after that end of the work as well as he can.

The sketch shows a device which was applied to a combination die into which a bar of ⅛ x ½-in. cold-rolled steel had to be fed.

The die itself was of a good construction but the only way to feed the stock was by hand. It had to



FEEDING DEVICE FOR PRESS TOOLS

be done rapidly and the sharp edges of the stock cut into the operators' hand, making the feeding difficult and retarding the work.

I came along to look after some parts of the die that had to be replaced, and the operator asked me if it was not possible to make something that would help him. Seeing that it was a simple matter, I made up a feeding device as shown in the sketch, applied it and found that it not only worked satisfactorily but increased the speed of the work as well.

The device is very simple and can be applied where semi-automatic operation can be used to advantage. Of course, a press equipped with automatic feeding attachments is preferable for quantity production, but for the small shop and under ordinary conditions this idea might be of value.

A is a block of steel in which a slot fitting the stock is milled. Apply *B* to the top of the block, thus providing a channel through which the work is guided into the die. *C* is a one-toothed pawl made of tool steel, hardened and ground to a sharp edge, which will grip the stock when the device is moved toward the die but will release when moved in the opposite direction. Drive a pin *D* through *A* on which the pawl can rock back and forth. A light spring *E* is applied in back of the pawl in order to hold it up against the stock. A lever *F* is pivoted to the die bed and held by a shouldered screw.

This lever is provided with a slot suitable to the movement of the device and the distance that the stock is to be fed for every stroke of the press. The

body of the device is provided with a stud fitting the slot in the lever and held to the same by a screw G under which a washer is placed to secure an easy sliding fit.

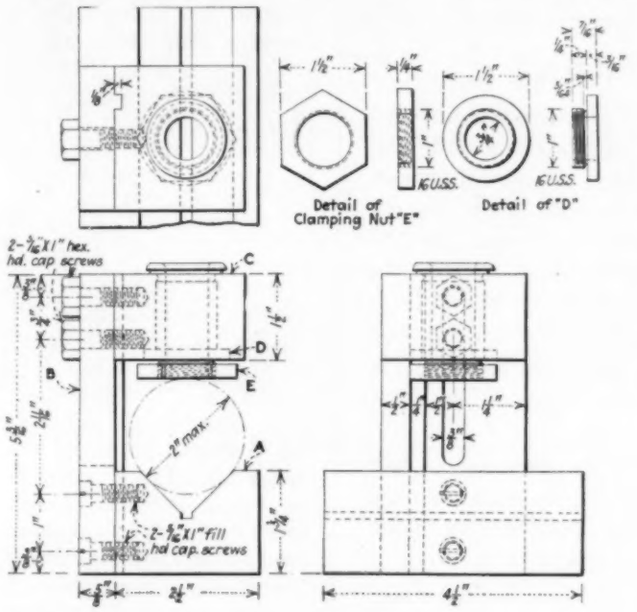
Jig for Drilling Transverse Holes in Shafts

By D. P. Roberts

The sketch shows a jig for drilling transverse holes centrally in shafts.

The upright piece *B* is attached to the V-block *A* by two $\frac{7}{16}$-in. fillister head screws set in flush with the surface so that they do not interfere when the jig is used in a vise on a drill press table. The movable block *C* is secured to the upright *B* by hex head capscrews and is adjustable to different heights to suit the work being drilled. The piece *D* is threaded for $\frac{3}{4}$ in. at the lower end with a fine thread, the upper portion being a force fit in the movable block.

In operation, the work is placed in the V-block, the hexagon head screws are loosened and the block lowered



JIG FOR DRILLING TRANSVERSE HOLES IN SHAFTS

until the nut *E* bears on the shaft to be drilled. The capscrews are then tightened, and the nut *E* adjusted until the work is firmly secured after which a drill bushing of suitable size is inserted.

A Recessing Tool for Automatic Turret Lathes

By E. L. Peterson

Some time ago the writer was requested to design a recessing tool, to be used in an automatic turret lathe for cutting inside recesses, as shown in Fig. 1. The problem in question was presented by the man in charge of the shop equipment at a large automobile factory, and I was asked to study the proposition thoroughly because a good recessing tool, it was stated, was needed in the shop for various purposes.

As a result the tool shown in Fig. 2 was built, tested out, and pronounced a "humdinger" by the shop supervisors. It works very satisfactorily.

The cutting tool *A* is carried by a slide *B*, through which a hole is made to fit the guide bar *C*. Slide *B* is dove-tailed in sleeve *E* which in turn is a sliding fit on shank *D*. A spring *F* tends to move sleeve *E* along

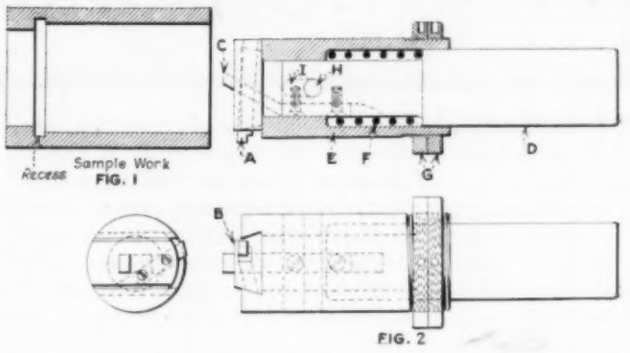


FIG. 1. THE WORK SHOWING THE RECESS. FIG. 2. THE RECESSING TOOL

shank *D*, but pin *H*, which is pressed in *D* and enters the oblong slot *I* in sleeve *E*, limits the movement of *D* in relation to *E*. The tool is held in the turret in the usual manner by means of shank *D*.

When the turret feeds the tool towards its working position the adjustable collars *G* on sleeve *E* engage the outer face of the work and sleeve *E* stops while the movement of *D* continues, and slide *B* is moved crosswise by means of the guide bar *C* which is fastened to *D*, thereby causing tool *A* to cut a recess in the work. The depth of the recess is dependent upon the angle at which the guide bar *C* and also upon the length the turret feeds after sleeve *E* has been stopped.

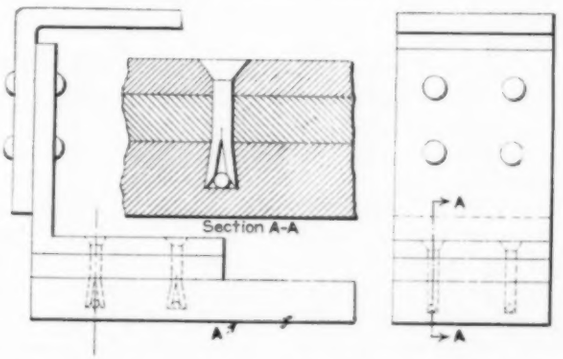
When the turret returns, the spring *F* holds sleeve *E* stationary until pin *H* engages the end of the slot *I* at which time the recessing tool has been disengaged from its working position permitting it to be withdrawn from the work.

Holding a Rivet in a Blind Hole

By F. G. McCormack

We had a job in the shop where it was necessary to rivet an angle and bar together with a filler between. The circumstances in this case made it necessary that the face *A* of the bar should be smooth.

We drilled the holes in the bar the size of the rivet shanks and inserted a dovetail cutter the same size as



SPLIT TAIL RIVET EXPANDED IN BLIND HOLE BY A BALL

the holes, milling first one side and then the other, as shown in the section *AA*. A ball was dropped in the aperture, and the split tail rivet driven in. We found this fastening to be permanent and successful.

IN THIS ISSUE

WE HAVE placed in the leading position this week an article by W. R. Reynolds and R. W. Sellew on "Comparison of Various Types of Ball Bearings." The authors show the relation between over-all width tolerances and radial play, these relations being mathematically demonstrated. They also take up the difference in radial play before and after mounting and the advantages and disadvantages of various types of ball bearings.

Colvin has two articles this week, pages 1068 and 1073. The first deals with the machining operations used in making connecting rods for the White motor, describing some unusual methods and fixtures. The second is the twelfth installment of his series "The Foreman and His Job." The specific subjects treated in the latter are the proper method of receiving the new employee in the shop and the foreman's influence in introducing new methods of manufacture or wage payments and new machines. In this connection, Colvin says, "The foreman who has been loyal to his job and has never tried to put over anything which was not fair, can be a tremendous force for good in introducing any new plan or method, whether this be a question of wage payment or the introduction of a new machine. And in the ever-changing problem of human relationship in and out of the shop, this is an important function."

Stanley, on page 1070, explains the method of handling locomotive driving wheel, axle and crankpin work in the Sacramento shops of the Southern Pacific Company.

The second of H. H. Manchester's short series, "A History of Post-War Crises," begins on page 1076. It takes up the period from 1860 to the World War, paying especial attention to the effects of war on finance and industry and furnishing a summary of post-war booms and crises. Mr. Manchester has discovered that " . . . the most obvious fact is that all of the big wars for the past five hundred years have been followed by boom times that have almost inevitably been short and in cases have led to some sort of crisis, or at least to a sudden fall in prices which have returned more or less nearly to the pre-war level." This statement jibes very nicely with one made by Professor Whitney, in our issue of last week, which was, "There is at least a strong possibility that the level of prices may ultimately go below those prevailing in 1913." As an isolated statement this quotation might give the wrong impression, but it will be remembered by those who carefully read the article referred to that it was qualified by the statements that such a low level of prices, if it should be attained, would not indicate permanently retarded business and that there can be a large, even an expanding volume, of business on a basis of low prices, as evidenced by experience in the United States during the period from 1873 to 1893.

Coming Features

At this time when nearly everyone has his attention focused upon educational matters, it is fitting that we run an article, such as will appear next week on the general subject "How Should the Engineer Be Educated?" Several men of authority have contributed brief statements that we are using to make up the article.

There will be a description by John Bath of some of the gages that he has developed. He has chosen as his title "New Light on Internal Measurements."

The second of the articles devoted to the description of types of plants will be in the next issue. It deals with the multi-storied shop of the American Tool Works Company.

The tenth installment of "Tool Engineering" will be the only series article.

The railroad article will be by Stanley; it tells of the use of the grinding machine in the railroad shop.

There will be another of the Puget Sound Navy Yard articles, this one dealing with special work.

The "Tool Engineering" article is rather short, covering only three pages. It begins on page 1078 and continues the subject of drill jig design. In this installment there are taken up closed jigs for angular and straight holes and locating and assembling jigs.

Morris, in his thirteenth apprenticeship article, describes the course used by the Westinghouse Air Brake Co., Wilmerding, Pa. The article parallels the previous ones, yet the contents add appreciably to the total information made available to our readers concerning the very thoroughly worked out courses employed by some of our largest manufacturers. Page 1081.

Next in sequence, page 1084, is a short article by A. A. Rodrick, Recorder of the United States Naval Labor Board, on "The Art of Interviewing." His statements are consistent with the ideas of many of the employment men of our large companies and other students of the personnel relation in industry.

This article is followed by the "Origin of the Milling Machine" by L. L. Thwing, an article of historical interest that gives the facts concerning the history of the machine in the United States and partially confirmed conjectures as to its origin and early development.

The last of the major articles is "Details of Crankcase Work," page 1088. This article, which is part of our special correspondence, describes various types of reaming fixtures, the value of running-in crankshaft bearings by power, and the use of roller conveyors.

EDITORIALS

One More Step Ahead

PRESIDENT HARDING has signed the budget bill which takes effect July first at the beginning of the new fiscal year. Thus we have taken one more step toward putting our Government on a business-like basis. Everybody has agreed for years that there should be a budget for national expenditures but the difficulty was always to get George up to the point of taking action. It is a matter on which the new administration deserves to be congratulated, not because the legislation is a party achievement, for its support has been largely non-partisan, but because the obstructions have finally been removed and the thing is done.

A word of warning to enthusiasts not to expect too much from the operation of a budget system may not be out of place. It must be remembered that perhaps seven-eighths of our annual expenditures will not be affected in any way by the introduction of a budget. The costs of previous wars are fixed charges which must be met.

Even conservative estimators, however, believe that it will be possible to save millions every year when the budget gets in working order. Three years, or even less, ago, mere millions would have seemed hardly worth bothering with but fortunately we have had a change of heart since then and economy has forged to the front. That this is true is an excellent augury for better times in the near future.

This Is No Time to Neglect Business

THERE are indications that some concerns are finding business much worse than it needs to be, by failing to take advantage of every opportunity that presents itself. There are many complaints that it takes longer to get answers to letters now than it did when every one was rushed. The same complaint reaches us concerning work to be done, such as castings, electroplating and the like. It seems almost unbelievable but the facts are there to prove it.

It is quite possible that the man who is far from busy himself feels that every one else is in the same boat and that a week's delay can make no difference to the man who writes for information. Nothing could be more in error or more fatal to the resumption of business. Orders are not coming to the man who sits at his desk and waits for the letter carrier to bring them in. They are going to the man who gets out and hustles, who keeps his name and his products everlastingly before those in his field. Every inquiry which is neglected may mean an order going to the other fellow, because men are not making inquiries for the fun of it, even though they do not buy immediately.

Now is the time to lay the foundation for future business by taking the best possible care of the orders which come your way. The men who are busy now are likely to be more busy and to be better customers as times improve. It is certainly desirable to see that they get the best service possible or they are likely to go elsewhere. And every customer lost makes it just that much easier for the sheriff to get the opportunity of tacking a foreclosure notice up on your door.

We are far from being pessimistic, but it is just as well to realize that some there be who will not survive the depression. And the first to go will be those who neglect opportunities for business, who wait for business to come to them as it did during the boom, and who fail to realize that only those who put up a stiff fight for business can hope to weather the storm.

The Permanent Tariff

THE emergency tariff law having reached a place on the statute books we are now called upon to consider the permanent measure which has been worked upon by the Ways and Means Committee for some weeks. As this is written full details of the new schedules are not available but those that have leaked out are not all promising.

Tariff legislation always has been and probably always will be a bone of contention in this and every other country. This bill will be no exception. Already violent protests on certain features have made themselves very evident and there are more to come.

The hope has been frequently expressed that the tariff makers would recognize the present as a propitious moment to institute a scientifically worked out tariff law, but the chances of realization of this hope are faint. Apparently class and sectional necessities are to rule over national advantages as in the past and the new law will leave us no better off than before.

The country, or at least its elected representatives, have not awakened to the fact that the war really made revolutionary changes in our economic status. The fact that we have most of the money in the world and are creditors of other nations to the extent of many billions which can only be repaid in goods does not seem to have penetrated if we are to believe the forecast of a high "protective" tariff to keep these goods out. We do not wish to be understood as condemning all tariffs, for we do not. Some of our industries need protection as a national insurance policy, and must have it.

From the point of view of the machinery builder the general tariff policy indicated is not cheerful. He must rely to a certain extent on foreign markets to absorb his surplus output and until they are in a sufficiently prosperous condition to pay for the machines they need, they might as well not exist at all. In other words we have got to trade if we are going to keep our mills and factories busy and trading never consisted of "everything going out and nothing coming in."

This tariff fight is a good one to watch, for your own interest is closely involved. Incidentally it may be well to put in an oar at the proper time. The President seems to be of the opinion that now is the proper time for his oar to be put in. His recent pointed remarks that Congress had been convened to act on tax and tariff measures were well merited. Let us hope they will be heeded.

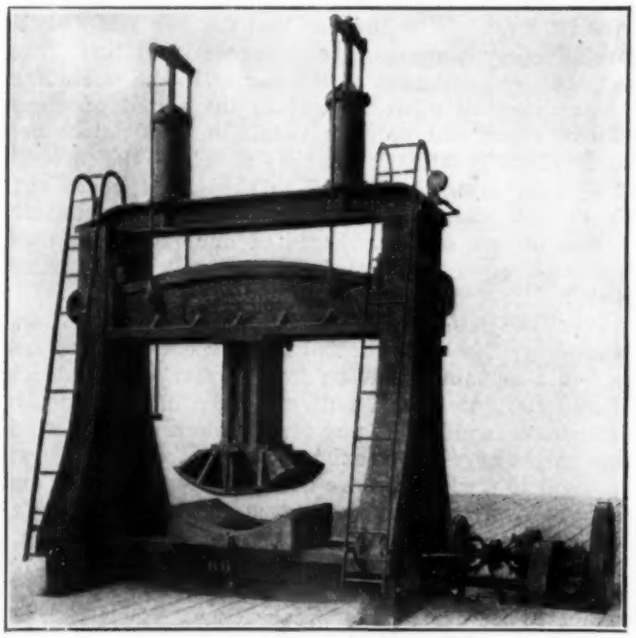
Shop Equipment News

Beatty Vertical Bulldozer

The Beatty Machine and Manufacturing Co., Hammond, Ind., has recently placed on the market the vertical bulldozer shown in the illustration. The principal features of the machine are claimed to be the simplicity of construction and the location of the driving parts. The main shaft is mounted through the lower bed instead of overhead, and the main side gears are enclosed in the box-type housing, with all intermediate gears fully enclosed. Clutches and high-speed bearings are easily accessible.

The side gears drive connecting rods secured to the crosshead. The machine is fitted with forward and reverse clutches which permit the machine to be reversed at any point of the stroke. It can be arranged for either belt or direct-connected-motor drive. The crosshead is fitted at both ends with bronze, tapered gibs for adjustment in case of wear to the slides. Air cylinders are used for counterbalancing the weight of the ram. All gearing is cast steel with cut teeth.

The bulldozer is especially adapted to work on steel cars, for the pressing and forming of such parts as diaphraghms, stakes, roofs, end sills and sheet-metal plate and bar parts. The dies shown attached to the machine are used for the forming of plates in tank-car tanks. The machine is built in sizes up to and including 500 tons ram pressure. The distance between the housings ranges from 8 to 12 ft.; and the vertical die space with the ram down and the adjustment in the center, from 24 to 72 in. The stroke varies from 18 to 24 in.; and the strokes per minute are 16 in the small



BEATTY VERTICAL BULLDOZER

size and from 8 to 10 in the large size. The smallest size weighs approximately 24,000 pounds, and the largest 120,000 pounds.

Stamets Gantry Drilling Machine

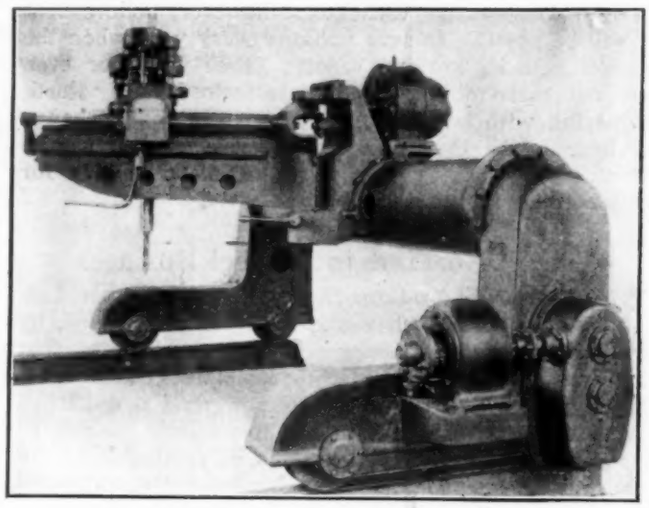
William K. Stamets, Jenkins Arcade Building, Pittsburgh, Pa., has recently brought out the gantry drilling machine shown in the accompanying illustration.

It will be seen that the machine is mounted on a track, the gage of which is broad enough to accommodate the plate to be drilled. The machine is traversed on the track by means of a motor provided with a suitable controller. The drilling head is mounted on the radial arm which swings on a support attached to the cylindrical crossbeam.

While the illustration shows but one drilling head and one radial arm, machines having several heads and arms can be furnished. Arms can be mounted on each side of the cylindrical crossbeam and more than one head can be mounted on each arm if desired.

The drive is by an electric motor mounted on the crossbeam. Either an a.c. multi-speed motor or a d.c. adjustable speed motor can be furnished.

The machine is adapted to the requirements of manu-



STAMETS GANTRY DRILLING MACHINE

facturers of steel cars, tanks, boilers or of any product where holes are to be drilled in plates.

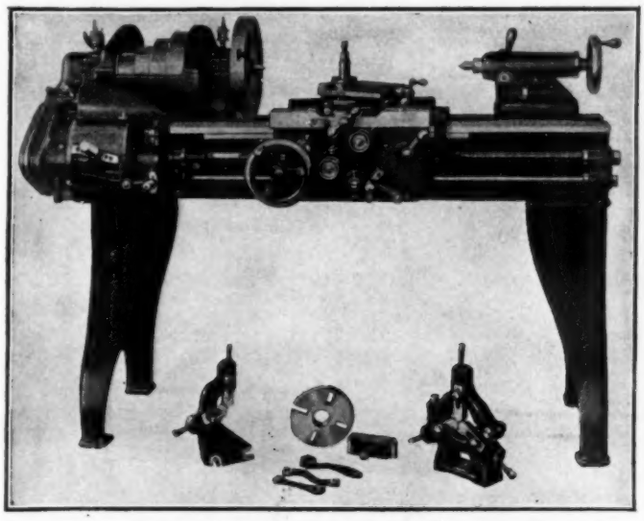
Since the machine is built only on order, the width of gage and number of arms and heads can be arranged to suit the purchaser.

"Economy" 12-Inch Quick-Change Lathe

A 12-in. swing lathe, shown in the illustration, has been added to the line of single-back-geared, quick-change engine lathes made by the Rockford Lathe and Drill Co., Rockford, Ill. A four-step cone pulley is provided for the drive, and is connected with back gears of a ratio of 8.06 to 1. The headstock bearings are made of a special composition metal. The spindle has a $1\frac{1}{16}$-in. hole through it, permitting the use of draw-in collets up to $\frac{3}{4}$-in. in capacity.

The tailstock is of the offset type to allow the compound slide to set parallel with the bed, and it is pro-

vided with a set-over for turning tapers. The carriage is provided with a thread indicator which can be disengaged when not in use, but which enables the proper engagement on a thread being cut without reversing the lathe. This permits both countershaft belts to run forward, thus giving sixteen spindle speeds. The apron has double bearings for all shafts, and the gears are of wide face and coarse pitch. All feeds are reversed in the apron, and their controls interlock with the bronze lead-screw nut, making it impossible to engage the lead screw and the feed shaft at the same time. A cam operates the lead-screw nut in one quarter turn. A redesigned quick-change gear box provides thirty-two changes of feed, obtained through sliding steel gears and hardened steel clutches. Special pitches of thread may be cut by substituting special gears on the quadrant. The lead-screw rotates only when in use for thread cutting.



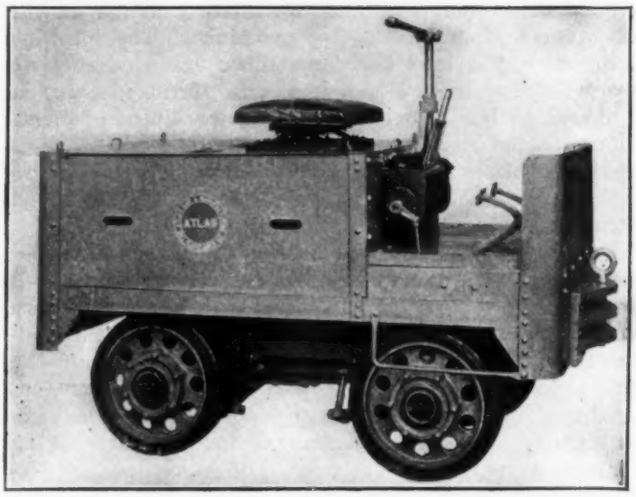
"ECONOMY" 12-IN. SINGLE-BACK-GEARED QUICK-CHANGE ENGINE LATHE

Specifications: Swing-over ways, 13 1/16 in.; over carriage, 6 3/4 in. Distance between centers with 5 ft. bed, 27 in. Lengths of bed, 5, 6 and 8 ft. Cone diameters, 3 3/4, 5 1/2, 7 1/4 in. Width of belt, 2 in. Cuts threads, 4 to 56 per inch. Feeds, 18 to 252 rev. per inch. Spindle speeds, 10 to 465 r.p.m. Size of tools, 1/2x1 in. Weight with 5-ft. bed: net, 1,300 lb.; domestic shipping, 1,520 lb.; export, 1,700 lb. Export box, 41 cu.ft.

Atlas Four-Wheel-Steer Tractor

The Atlas Car and Manufacturing Co., 1130 Ivanhoe Road, Cleveland, Ohio, has recently placed on the market the fourlwheel-steer tractor shown in the accompanying illustration. This tractor, designated at Type TE, uses electricity for the motive power and is designed for industrial transportation. The principal feature of the tractor is the four-wheel-steering apparatus which is said to make the machine convenient for use in places that might be difficult of access for tractors without this feature. The tractor can be furnished with either two or four-wheel drive. It can also be supplied as a four-wheel-drive rail locomotive by substituting flanged steel wheels for the rubber-tired ones and omitting the steer-mechanism. This is known as type RTE4, and is built for 20, 24, 30 and 36-in. gages.

The driving axles are of the full floating type with removable drive shafts. Bolted clutch plates are provided. Bearings are of the high-duty, ball, radial and radio thrust types, with oversize bearings in the wheels. The brakes are of the external contracting shoe type. The controller is of the drum type, entirely enclosed, giving three speeds in either direction. The circuit

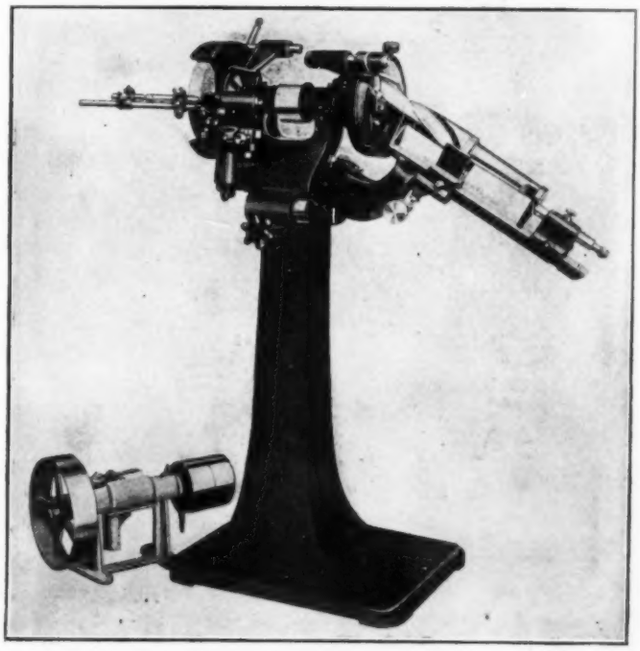


ATLAS FOUR-WHEEL-STEER TRACTOR

breaker is integral, operated by means of a pedal. A "Powerlock" differential is used. The tractive effort is under normal conditions, 400 lb. with an ultimate of 2,000 lb. The drive is through a bronze wheel and steel worm, entirely enclosed and immersed in an oil bath. The motor is of the vehicle type, entirely enclosed. Edison battery equipment 42 cells of A6 or G9 type being used. The speed is 6 miles per hour without load. The tires are solid rubber, and 20 x 3½ in. in size. Weight, with Edison battery, 3,950 lb.; with lead battery, 3,700 lb. Boxed for export, with Edison battery, 4,450 lb.; with lead battery, 4,550 pounds.

Grand Rapids Combination Tap and Drill Grinding Machine

The illustration shows the combination tap and drill grinding machine which has just been placed on the market by the Grand Rapids Grinding Machine Co., Grand Rapids, Mich. This machine is designed to meet the requirements of the shop having need for correctly



GRAND RAPIDS COMBINATION TAP AND DRILL GRINDING MACHINE

ground drills and taps, and is said to combine all the advantages of single-purpose machines. The machine automatically grinds the same taper and clearance on every flute. The drill-grinding side of the machine is equipped with a holder stop, which, working in connection with the base of the diamond truing device, automatically places the drill holder in proper relation to the face of the grinding wheel. This is said to be an exclusive feature of the machine.

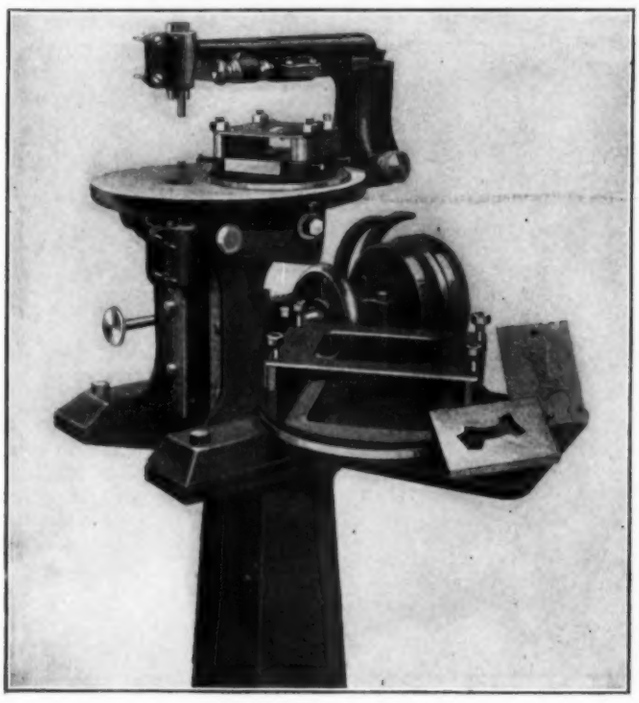
Both wheels of the machine carry a wheel-truing mechanism with diamond. With the No. 10-A and 10-B machines, two types of wheel-truing devices are furnishing, one for truing the periphery of the tap-grinding wheel, the other for truing the face of the drill grinding wheel. In the case of No. 20-B and 20-C machines, both wheels are cup shape and the diamond-truing device is arranged for keeping the face of the wheel in proper shape. Diamonds of approximately one-half carat are furnished for each wheel. The No. 10A machine grinds taps from No. 6 to 1¼ in. and drills from No. 52 to ¾ in.; the No. 10B machine, taps from No. 6 to 1¼ in. and drills from ⅛ in. to 1¼ in.; the No. 20B machine, taps from ⅜ to 3 in. and drills from ⅛ to 1½ in.; and the No. 20C machine, taps from ⅜ to 3 in. and drills from ¼ to 2½ in.

Specifications: Spindle speed, 1,600 r.p.m. Diameter of grinding wheels, 8½ and 10 in. Speed of countershaft, 560 r.p.m. Height to center of spindle, 44 in. Floor space, 2 x 3½ ft. Net weight, 385 lb. for No. 10 grinder. 400 lb. for No. 20 grinder. Crated weight, 450 and 500 lb., respectively. Boxed weight, 550 and 625 lb., respectively. Export box, 16 cu.ft.

Hawkes Die- and Templet-Making Machine

The machine shown in the illustration is a die- and templet-making machine, which has been developed by R. L. Hawkes, 212 Niagara St., St. Catherines, Ontario, Canada. The machine is intended for the production of dies, punches, templets, and similar tools at a lower cost and in less time than is possible with hand work. It is stated that an unskilled operator can, with a few instructions, make accurate tools, ready to be hardened.

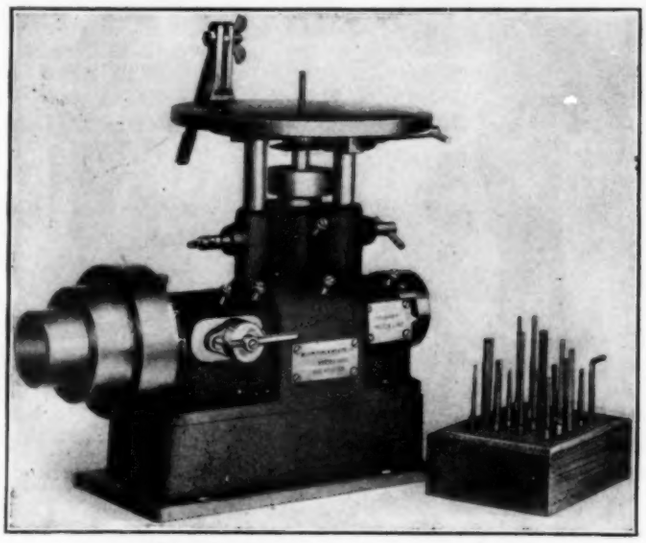
To operate, the die blank or templet is roughed out and then placed in the fixture shown on the table of the machine. Then the guiding finger, which projects downward from the overhanging arm, is set to follow the outline of a design or similar templet on the top of the fixture, the cutting tool, which is a file, following the design and thus shaping the work in the fixture. At any stage of the operation the file or the guiding finger may be moved, raised, or lowered, the fixture removed and the die checked from the back side for accuracy, after which it can be replaced and the operation continued as before. A micrometer dial at the right-hand side of the machine makes it possible to set the machine as accurately as desired. The file used is about 8 in. long and operates as a draw-file. Various shapes of files can be used according to the profile of the work.



HAWKES DIE- AND TEMPLET-MAKING MACHINE

Boston Universal Filing Machine

A bench filing machine having a reciprocating movement for using ordinary files in the regular manner, or a rotary motion for round files or special milling cutters,



BOSTON UNIVERSAL FILING MACHINE

is now offered to the market by the Boston Tool & Manufacturing Co., 262 Dover St., Boston, Mass.

The machine is little if any larger than the usual form of bench filing machine. The table can be tilted to any desired angle for the purpose of giving the requisite draft to dies, etc., and the machine is equipped with a three-step cone pulley.

An arm is supplied to be bolted to the table in such position that it will furnish a rigid support to the upper end of the file. The change from reciprocating to rotary motion is effected by turning the lever in front through a half revolution. The working parts of the machine are enclosed within the base and thus protected from dust and filings.

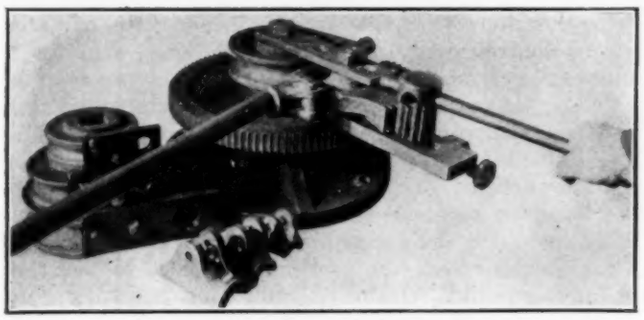
The manufacturers of the machine are prepared to furnish special files made with inverted teeth so that the pressure upon the work will always be downward whether using the reciprocating or the rotary movement; thus freeing the operator from the necessity of holding the work down.

The reciprocating files are made parallel so that the angle of clearance in the work is determined wholly by the angular setting of the table. The rotary files are tapered to suit the angle of clearance and the table set square with the axis of the spindle.

The machine occupies a bench space of about 9 x 12 in. and stands 11 in. high. The chuck is adapted to hold file shanks ¼ in. in diameter. The circular table is 7 in. in diameter and the stroke is sufficient to finish dies 1¼ in. in thickness.

Leonard Pipe-Bending Machine

The illustration shows a pipe-bending machine which has recently been placed on the market by the Leonard Machine Works, 1023-27 Race St., Philadelphia, Pa. This machine is made in three sizes, No. 1, which bends pipe from 0 to ½ in., No. 2 from 1 to 2 in., and the No. 3 from 2 to 4 in. The No. 1 machine, which is shown,



LEONARD PIPE-BENDING MACHINE

can be furnished with or without a floor pedestal, while the No. 2 and No. 3 sizes are furnished with the floor pedestal as regular equipment. Each machine is equipped with four forming heads and four bending shoes, and special shoes can be furnished for handling unusual work.

The machine consists of a cast-iron base, in the center of which is a solid steel spindle. Tightly fitted to this spindle is a ratchet wheel, and keyed on above the ratchet wheel is an arm which is free to swing around the spindle. The arm, which is of cast steel, has several tapped holes in which the center studs for the shoe-carrying gear segment and pinion are mounted. The pinion is made of steel and case-hardened, and has two large holes at the top drilled at right angles to each other, and in which the hand-lever is inserted when operating the machine.

To operate, the pipe is slipped through the guard that protrudes from the forming head, and then the small pinion is rotated until the shoe is in contact with the pipe. As the hand lever is swung around, the pipe is bent at the forming head. Suitable forms and shoes are made for each size pipe. The machine with all forms for 1, ¾, ½, and ⅜-in. pipe weighs 115 lb., and with a stand, 225 pounds.

Changes in B & S Small Tools

The latest micrometer depth gage, made by the Brown & Sharpe Manufacturing Co., Providence, R. I., and shown in Figs. 1 and 2 is obtainable with either a 2½ or 4 in. base. It is furnished complete with three measuring rods which enable readings from 0 to 3 in. to be taken by thousandths of an inch, the micrometer screw having a movement of 1 inch. The selected rod can be placed in position by removing the cap *A*, Fig. 2, which when replaced brings the nut on the rod against the seat *B*. Using the nut as a shoulder permits individual adjustment of the rod. Adjustment is provided for wear of the threads on the micrometer screw.

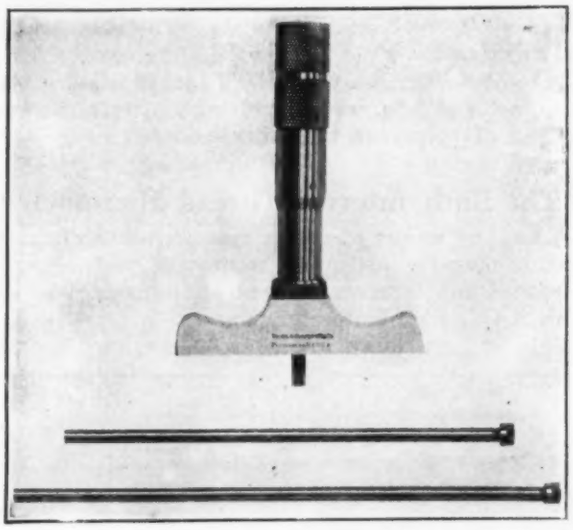


FIG. 1. B & S MICROMETER DEPTH GAGE

The tempered hook rules Nos. 320 and 325, now have a reversible hook of simple design and are provided with a shoulder to assist in setting dividers and calipers. The hook is held firmly and squarely on the rule by a screw and can be easily removed to permit the use of the rule alone.

The center heads now furnished with the combination squares are ground so that both arms are of equal length and the points, *A* and *B*, Fig. 3, are equidistant from the

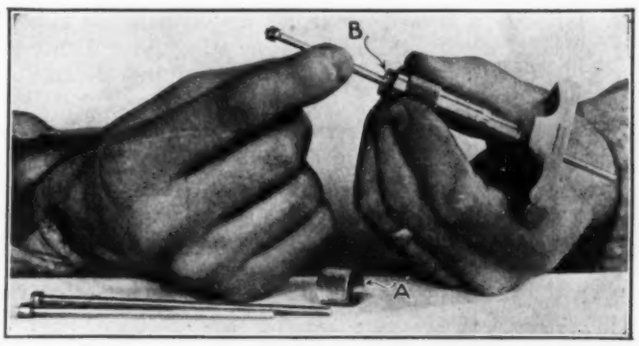


FIG. 2. METHOD OF INSERTING MEASURING RODS IN DEPTH GAGE

edge of the scale. This permits the use of the center head on work of large diameter as shown by the dotted arc.

Vernier calipers Nos. 570 and 571 either in English or metric measure are now made to read outside dimen-

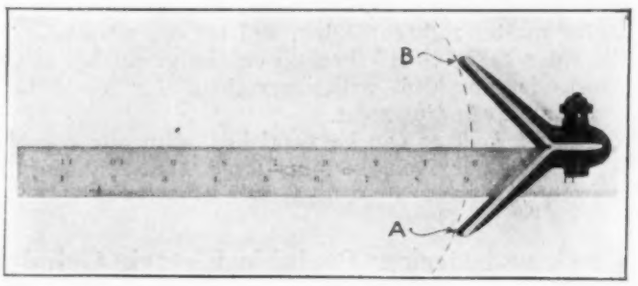


FIG. 3. B & S CENTER HEAD

sions on one side and inside measurements on the other, each side having its own vernier. The readings are direct, that is, there are two deductions to be made for

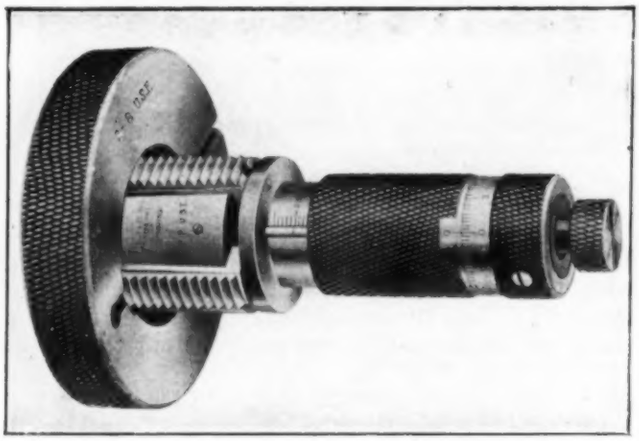
thickness of the jaws as formerly. The above changes also apply to the 10 in. vernier height gage No. 585.

Thickness gage No. 644 is now furnished with blades 3 in. long and ½ in. wide, no change being made in the number of blades or their thickness.

The Bath Internal Thread Micrometer

A tool, by means of which measurements of internal threads may be easily and accurately made, has been developed and is manufactured and marketed by John Bath & Co., Inc., Worcester, Mass.

This tool, as shown in the accompanying illustration



THE BATH INTERNAL THREAD MICROMETER

is distinctly a thread micrometer. With it the size of a tapped hole, ring thread gage, or other internal thread may be obtained directly in units of tenthousandths of an inch.

The four measuring jaws are supported and held in alignment by close fitting dovetail slots in the body of the micrometer, and may be adjusted for size by means of a micrometer screw and graduated sleeve. The moving parts are nicely lapped and fitted without play and the micrometer is claimed to be as rigid as a solid plug, thus enabling any number of persons to secure the same measurement on a given piece.

The micrometer is first ground and lapped when set at the nominal hole size, after which it is ground when set at the smallest, and also at the largest dimension. This subsequent grinding relieves the threads at each side of the center of the measuring jaws and insures line contact free from interference due to the change in the angle of the helix from the smallest to the largest measurement.

Adjustment is provided so that when wear occurs on the measuring jaws, the micrometer may be referred to the master reference ring, and set correctly to size, the wear being then taken up on the graduated collar which is provided with serrations for each tenthousandth of adjustment.

The micrometer can be furnished, with any number of threads per inch, in sizes from 1 to 5 inches in diameter.

Black and Decker Portable Electric Grinder

The Black and Decker Mfg. Co., 111 S. Calvert St., Baltimore, Md., has perfected a portable electric grinder which embodies the principal features of the portable electric drill (made by the same concern). The grinder, as shown in Fig. 1, is equipped with a pistol grip and

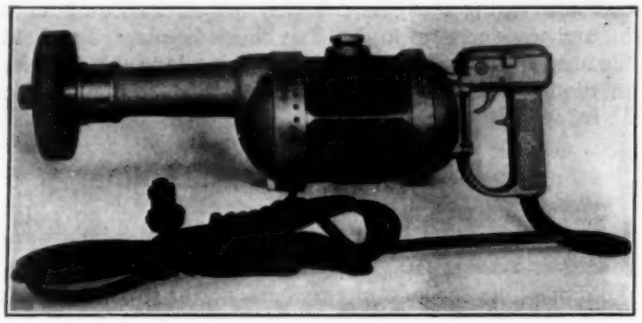


FIG. 1. BLACK AND DECKER PORTABLE ELECTRIC GRINDER

trigger switch which, it is claimed, gives the operator entire control over the tool at all times, making it unnecessary to shift either hand to start or stop it.

While this machine is essentially a portable grinder, it is supplied complete with quick detachable base and adjustable toolrest, as shown in Fig. 2, so that it can be used with equal facility as a bench grinder. Besides the base, the equipment includes two 5 x 1-in. grinding wheels one fine and one coarse, a wire brush wheel, and a rag buffing wheel. This outfit is intended to take care of any grinding, cleaning, buffing or polishing jobs around garages, service stations, vulcanizing shops, machine shops or foundries.

The machine is equipped for grease lubrication throughout, has forced air cooling, chrome-nickel steel gears and shafts, and aluminum alloy housing. The grinder can be operated with either direct or alter-

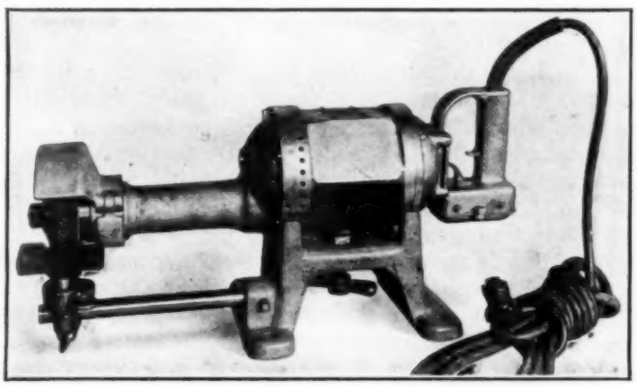


FIG. 2. GRINDER WITH BASE AND TOOL REST

nating current, as desired. The principal specifications are: motor, ½ hp.; speed, no load, 3,200 r.p.m.; wheel size, 5 x 1 in.; diameter of wheel arbor, ¾ in.; and net weight without base, 21 pounds.

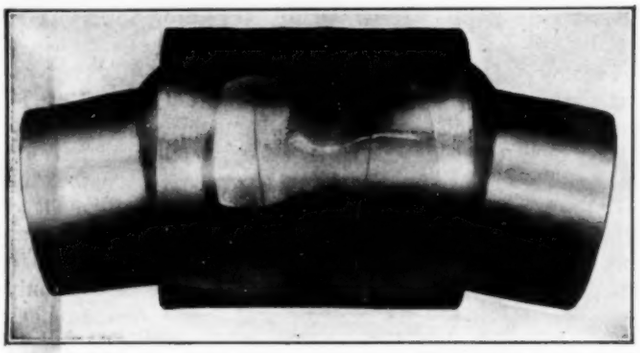
Whitney Free-Floating Coupling

The Kay Manufacturing Co., South Norwalk, Conn., has recently placed on the market the Whitney free-floating shaft coupling, the construction of which can be seen by the accompanying phantom view of the device. The coupling allows for both parallel and angular misalignment of the shafts being connected, as well as providing for axial movement, such as the floating of an armature.

The power is transmitted from the driving to the driven hub through a floating link. A casing surrounds the parts, the hubs being prevented from slipping out by retaining rings fastened in the ends of the casing by means of screws and fitting on the spherical inner

ends of the hubs. There are no projecting flanges or pins on the coupling, the exterior of which is smooth so as not to catch the clothing of a workman. The coupling is small in diameter, and compact and simple in construction. The device is adapted to the coupling of line shafts, to the connection of motors and generators, and to any use where it is necessary that two connected shafts should each run freely in their own bearings and not bind because of misalignment.

The hubs have square holes cast in the large ends, into which the ground ends of the semi-steel link fit. The link can thus slide in the holes and swivel in any direction, because of the rounded shape of its ends.



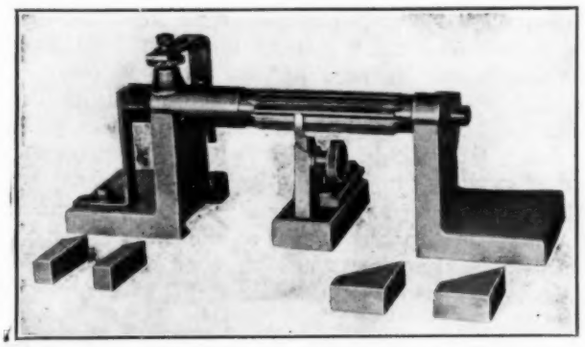
WHITNEY FREE-FLOATING SHAFT COUPLING

The smallest part of it is thicker than the shafts being connected, so as to provide sufficient strength to transmit the torque.

The coupling is said to provide a positive driving joint with but little back lash and great flexibility, and to operate smoothly and without noise at any speed. It is made in sizes to fit shafts from $\frac{7}{8}$ to 6½ in. in diameter, although couplings having special and tapered bores can be furnished. The outside diameters vary from 2½ to 14 in., the overall lengths from 4¾ to 24 in., and the maximum speeds from 3,600 to 900 r.p.m.

G. L. Wood "Common Sense" Reamer-Grinding Attachment

The illustration shows a reamer-grinding attachment recently placed on the market by G. L. Wood, 16 Stafford St., Worcester, Mass. The device is known as the "Common Sense" reamer-grinding attachment, and although adaptable particularly to hand expansion



"COMMON SENSE" REAMER-GRINDING ATTACHMENT

reamers having pilots, it is applicable also to the grinding of machine reamers, boring bars, pin-cutter bars, and taps. Reamers from ½ to 2 in. in diameter can be held.

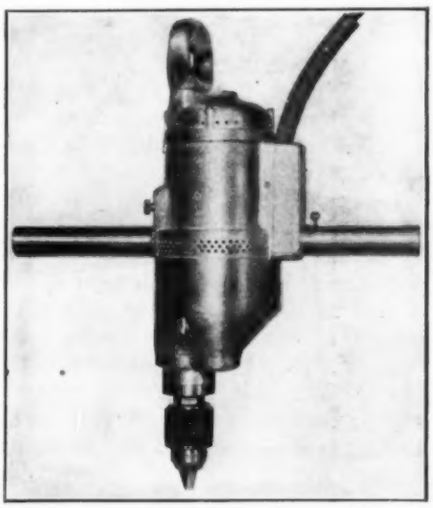
The reamer is expanded a sufficient amount to permit of the removal of the dull edge, and is then ground to size. It is said that the reamer can be kept to proper size throughout its entire length as long as it is expandable. Since the work merely rests in V's, reamers mounted on shafts can be ground without removing them from the shafts. Machine reamers can be ground without the use of the center hole on the reamer end of the tool, if necessary, by merely transposing the standard and allowing the reamer end to extend over one standard. The cutters of boring bars can be ground without removing them from the bars, any angle of rake or clearance up to 5 deg. being obtainable.

The device consists of two V-notched standards, a tooth rest to prevent the work from turning, and three sets of parallel blocks. The standards are made in two sizes, and a stop or friction device adjustable to either standard is provided. The standards, as well as the tooth rest, are machined to dovetail on standard grinding machine tables, and they are held in place by means of set screws. The position of the tooth rest can be controlled by means of a set screw. The parallel blocks are provided for raising the work up to the proper height on the two standards, and they give $\frac{5}{16}$-, 1½- and 1$\frac{11}{16}$-in. raises.

Machine and hand taps can be reground when broken, by cutting off the broken end and grinding any angle of taper and relief by the use of the tooth-rest gage.

Louisville Two-Speed Portable Electric Drill

The Louisville Electric Manufacturing Co., Thirty-first and Magazine Streets, Louisville, Ky., has recently developed a line of portable electric tools such as drills, grinders, motors, etc., among which is the No. 3 two-speed Universal drill shown in the illustration. This drill operates on either direct or alternating current. The speed changes are obtained by shifting a small knob located close to the handle, which can be done while the drill is running at full speed. The switch for operating the motor is controlled by a small knob on the handle. The gears are made of heat-treated chrome-nickel steel. The frame is of aluminum throughout and is force-ventilated for cooling. Jacobs chucks are a part of the standard equipment.



LOUISVILLE TWO-SPEED PORTABLE ELECTRIC DRILL

The drill shown has a capacity of ½ in. on high speed and $\frac{5}{8}$ in. on low speed. It is equipped with ball bearings throughout. The diameter of the gear case is 5 in. and the spindle is offset 1$\frac{3}{8}$ in. from the side of the frame. The length over all is 17½ in. and the weight 19½ lb. A breast plate, interchangeable with the spade handle, can be furnished.

Pipe Dreams of a Tramp Machinist—Johnny Inspects the Sprinklers

BY GLENN QUHARITY

The Brookdell shops were equipped with sprinklers even earlier in the game than many other shops, for our old Mr. Brooks was quite a progressive man and quick to see the advantage of any new device that would benefit his business or insure its continued activity.

From the nature of the business conducted the plant was what modern insurance men would style a "bad risk" because of the vast quantities of stored lumber, the huge dry kilns and, further, from the presence near the center of the plant of a detached brick building

JOHNNY VERSUS SEVENTY-FIVE POUNDS OF WATER

where no work was ever done after nightfall, where no man dared go with matches in his pocket, and before entering which the night watchman used to set his lantern down in the yard—"the celluloid room."

In my apprentice days every room bristled overhead with sprinklers; every room had at least one standpipe pipe with permanent hose connections, and the yard was underlaid with water mains with hydrants at every point of vantage; all connected to a powerful waterwheel driven centrifugal pump located in the wheel pit, where no fire could ever put it out of business, and controlled by gates outside the shop.

The sprinkler system demanded constant pressure, for it was what is now called a "wet" system with water always at the sprinkler heads, and this pressure was supplied from a small reservoir on the hillside above the town. For this reason the pressure was somewhat higher than is usually obtained on similar systems supplied by tanks—about 75 lb. per square inch. That such a plant has stood for over seventy years—not all of it all that time—in a town with no fire protection without a serious fire speaks well for the foresight and vigilance of its executives.

All piping in and about the plant, whether steam, water or gas—we had a private gas plant 50 years ago—was under the supervision of the "boss of the machine room" (we didn't know what a "master mechanic" was in those days) and his boys made all necessary repairs and additions and saw to it that everything, especially the fire-protection service, was always in readiness for action.

We even had an "injin"—one of the old time double pumps on wheels, operated with long hand levers; but this was more ornamental than useful after the big power pump was installed. The "fire brigade" had rubber boots, red shirts, helmets, 'n everything, which they dutifully donned whenever we had a picnic. If ever a fire started there wasn't time.

All this has, perhaps, little to do with Johnny and the sprinklers, but it serves to show how Johnny came to be on inspection duty one Saturday afternoon.

All the old-time sprinkler heads had a screw in the side that could be partly withdrawn for testing purposes. If this screw upon being taken out did not allow water to escape there was something wrong with the pipes that had to be investigated there and then. It was not necessary to take this screw clear out—in fact it was highly desirable *not* to take it out—in order to be sure that the pipes were clear, for if the screw came out and the water was "there" somebody was going to get very wet before it could be put back.

Johnny was making the rounds one Saturday p.m. with stepladder, screwdriver and bucket, the latter to keep the slop off the floor and machinery, and had nearly completed his job when he arrived at the pattern shop. The patternmaker kept his particular stock of pattern pine and other choice woods in an overhead sling, same as most patternmakers do, and there was one sprinkler head over this sling that was so close to the lumber beneath it that Johnny could reach it only by crawling over the lumber and lying on his back under the sprinkler.

It was hot up there; Johnny was tired of his job and was dreaming of what he was going to do tomorrow after Sunday school. Besides, he had left his bucket out of reach. Somehow that darned screw got out and went rattling down in the chinks between the planks on which he was lying, and—the water was *there;* 75 pounds of it.

Johnny got his thumb over the hole and frantically searched under him with his left hand for the missing screw; meanwhile hollering for help. If you have ever tried to hold 75 lb. of water with your thumb, even though the orifice is only ⅛ in., you know what Johnny was up against.

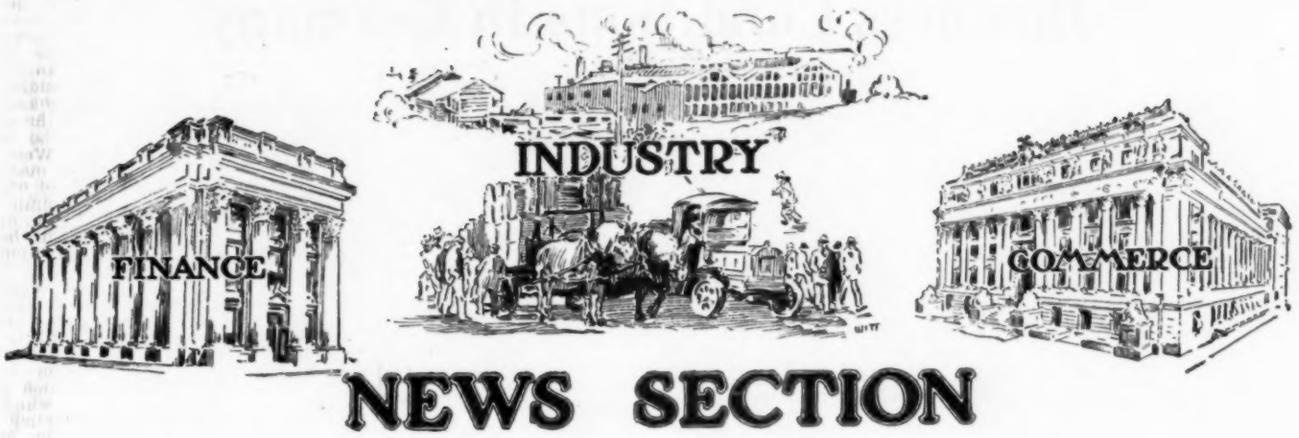
Though the patternmaker was out, Johnny's cries were heard and the youngest cub came running to see what the trouble was. As his face rose over the edge of the stack of lumber like a full moon on a rainy night Johnny's thumb slipped long enough for Cub to get a shower of water in his eyes, and he hastily retreated: calling back to Johnny to "hold 'er till I shut off the valve in the branch."

His idea of shutting the valve in the branch was first to assemble all of his comrades that he could find to take a peek at Johnny holding back the flood like the little Dutch boy we used to read about in the "Third Reader," who saved the town by holding his thumb in a hole in the dyke, until Johnny, sensing the cause of the delay, let go his hold, crawled out from under the gushing sprinkler and slid to the floor.

He was very wet and very mad; but the patternmaker, who came rushing to the scene to find what the fuss was about, was still madder when he found that "a passel of damfool boys had ruined a thousan' dollars worth o' patt'n lumber."

The valve was shut, the screw found and replaced, and the drenched lumber hauled out and sent to the dry kilns; the boys doing the hard work. Johnny was sore—where the patternmaker hit him; and Cub got a licking after six o'clock.

Johnny and me didn't speak for nearly two weeks.



NEWS SECTION

Three Washington Conferences

The Fourteenth Annual Conference on Weights and Measures was held at the Bureau of Standards on May 23-26. Invitations had previously been sent to the governors of states, mayors of various cities, and weights and measures officials throughout the country. The governors of those states which do not maintain an office of weights and measures were in every case urged to appoint delegates to the conference and many took advantage of this opportunity to send a representative to the Bureau. Manufacturers of apparatus and persons engaged in weights and measures work for industrial concerns, associations, etc., were also present. Several of the manufacturers had on exhibition various weights and measures appliances, including liquid measuring pumps, machines for automatically measuring the yardage of cloth, scales of all sorts, etc.

The main object of these conferences is to secure uniformity in weights and measures standards and laws and in the enforcement of the latter. Only fundamental questions of weights and measures are considered; the aim of the conference being rather to direct the general subject than to go too much into detail. Among the speakers were: Mr. Herbert Hoover, Secretary of Commerce; Dr. S. W. Stratton, Director of the Bureau of Standards, and numerous officials of State Weights and Measures Departments. The subjects treated included the sale of bread by weight, detection of shortages, weighing of coal, and tests of liquid measuring pumps.

Aeronautical Safety Code

On May 13, a conference was held in Washington to consider the development of an Aeronautical Safety Code for which the Bureau of Standards and the Society of Automotive Engineers have been designated as the joint sponsors by the American Engineering Standards Committee. This conference was attended by representatives of the War, Navy, and Post Office Departments, The National Advisory Committee for Aeronautics. The National Safety Council, Manufacturers' Aircraft Association, and the Insurance Underwriters, as well as representatives of the two sponsors and the American Engineering Standards Committee.

It was the sense of this conference that a safety code ought to be developed without delay and that a committee should at once be formed which would include representatives of all organizations interested in this subject as well as those which were present at the conference. Invitations have, consequently, been extended to other interested organizations.

Standard Tests for Automobile Brake Linings

At a conference recently concluded at the Bureau of Standards, recommendations were made for a standard method of testing brake lining materials for automotive purposes. The engineers of the Bureau discussed these recommendations with representatives of nearly all the manfacturers of this class of material, as well as of the Motor Transport Corps of the Army and the Standards Committee of the Society of Automotive Engineers.

In view of the very large quantities of brake lining material used in automotive vehicles today, the establishment of standard test conditions which may be used by all makers and large users and which can form the basis for purchase specifications is of considerable importance, not only to the industry but also to the public. Such standards carefully planned tend to bring about a greater uniformity of the materials concerned, and by establishing a better understanding of the essentials leave the manufacturer free from unnecessary restraint in other directions, so that he may use all his energy and ingenuity towards the improvement of the materials and his methods of production.

The Steel Treating Society Convention

The National headquarters of the American Society of Steel Treating has announced the list of manufacturers who have contracted for space to exhibit their products at the Indianapolis Convention and Exhibition Sept. 19 to 24.

While the date for the opening of the Convention is still three months off, the 50 firms listed below have arranged for space. There are a large number of uncompleted contracts in the National office, and indications are that the Indianapolis show will be larger than the one held in Philadelphia last fall.

The interest being aroused on the part of the members of the Society and the exhibitors assures a very large attendance. This year, more manufacturers will have their exhibits in operation than in any previous exhibition. An excellent opportunity will be afforded to observe manufacturers' products under actual operating conditions.

A list of exhibitors to date follows:

Selas Co., Economic Gas Appliances in operation; Chas, Englehard, Recording Instruments in operation; Smith Gas Engr. Co., Produce gas machines in operation; Geo. J. Hagen Co., oil and Gas furnaces in operation; Westinghouse Elec. & Mfg. Co., elec. appliances in operation; Brown Instrument Co., Recording instruments in operation; Midvale Steel & Ord. Co., operating exhibit of steels; Indianapolis Drop Forging Co., forgings in operation; Calorizing Corp. of Pittsburgh, Calorizing process in operation; Deeds Commercial Laboratories, Carb. Compounds in operation; Leeds & Northrup Co., Elec. fur. and record. instrs. in operation; Tate-Jones & Co., furnaces; Armstrong Cork & Insulating Co., insulating materials; Taylor Instrument Co., Pyrometers in operation; Ludlum Steel Co., steels; Marschke Mfg. Co., Elec. grinders and buffers in operation; Simonds Steel Co., steels and saws in operation; General Electric furnaces in operation; Wm. Ganschow, gears; Bristol Company, recording instruments in operation; Eaton Elec. Furnace Co., electric furnaces in operation; Bethlehem Steel Co., steels; Spencer-Turbine Co., blowers in operation; Driver-Harris Co., alloy pots and boxes; Crucible Steel Co. of America, steels; Electric Steel Co. of Indiana, castings; Halcomb Steel Co., steels; Atlas Crucible Steel Co., steels; Bell & Gossett, case hardening materials; Iron Age, publications; Deeds & Chapin, "Cinch" cement; General Alloys Co., alloy pots and boxes; Electrical Refractories Co., refractory materials; W. S. Rockwell Co., oil and gas furnaces; Electric Alloy Steel Co., alloy steels; Colonial Steel Co., steels; Herman A. Holz, Inc., metallurgical equipment; Imperial Drop Forge Co., forgings; Vanadium Alloy Steel Co., steels; Heppenstall Forge & Knife Co., die blocks; E. C. Atkins, metal saws and cutting machines; Mahr Mfg. Co., furnaces.

Poles Anxious to Buy Goods Here

Caesar Lozinski, director of the Polish purchasing bureau in the United States, who has just returned from an extensive trip in Poland, has issued, through the American Polish Chamber of Commerce, 40 West Fortieth Street, a résumé of conditions in this country and of its needs.

"Polish manufacturers are in the market to purchase American tools and machinery needed to equip their factories for raising the basis of production to the pre-war level," said Mr. Lozinski. "It is hoped that it will not be necessary for Poland to import large quantities of foodstuffs this year. The present outlook for the crops is favorable, and, barring untoward events, domestic production should supply the country's needs in this respect. But large quantities of machine tools, electrical machinery, chemical apparatus and equipment parts for the existing factories will have to be imported by Poland from America or from her European competitors in these lines, according to the attractiveness of the terms offered.

"Ever since the signing of the peace with the Bolsheviki, the feeling of security in Poland has been growing. The army has been demobilized until at present only about 300,000 men are under arms. There is a marked desire on both sides to open up trade over the Polish-Russian border and already a very considerable movement of persons and trade is going on. In spite of handicaps, private enterprise is finding a way to get into Russia. What Poland most desires from this country is the investment of American capital in Polish industries. It is difficult for Americans to realize that in spite of the low value of the Polish mark, Poland is very much alive. Everybody is working. The standard of living is improving."

"Garabed" Amendment Suggested

An amendment to the "Garabed' 'resolution adopted by Congress February 8, 1918 has been introduced in both the houses of Congress. The amendment proposes to make section 3 of the original resolution read as follows:

"That if such demonstration shall, in the opinion of the said scientists, prove the practicability of said discovery or invention, and that it can substantially effect the purpose set out in section 1 of his resolution, the said Garabed T. K. Giragossian shall be recognized by the United States Government as the original discoverer, inventor and legal owner of the invention or discovery and of any improvements pertaining thereto that may be made by said Garabed T. K. Giragossian. The certificate of said commission of scientists, to the effect that said discovery or invention is practicable, as aforesaid, shall constitute the said Garabed T. K. Giragossian the legal owner of and entitle him to all the rights and benefits of said discovery or invention for a period of seventeen years. The right is reserved to the said Garabed T. K. Giragossian, his heirs and assigns, to take out patents for his aforesaid discovery, invention, or for any improvement or device pertaining thereto."

It is amazing that, with so many vital problems before the country members can be found who will waste time and money on things of this sort. The merits of "Garabed" have already been investigated by a competent commission and found wanting.

Business Conditions in Germany

By Our Berlin Correspondent

The acceptance of the ultimatum, foreshadowed in the last Berlin letter in these columns, is an event which in its importance and consequences for Germany can hardly be overrated. The retrograde movement, which could be observed in all branches of the country's economical life, characterized by the tendency to let everything drift, has come to a halt, and the people are again looking the future in the face. The Upper Silesian problem is, however, still causing great anxiety, and until it is settled definitely it can hardly be expected that brain and will power, which of late have become more and more an inert quantity, will move on the road which the country will now have to traverse. The future can hardly be recognized yet even in dim outlines, and it will probably take months until the business man will be able to shape his course with a certain amount of confidence. During the past months of unsettledness, the same disastrous state of affairs which followed the revolution has again come into effect, characterized by speculation taking the place of calculation.

To restore the normal order of things in this respect will be the first task of the business world. It can only be performed by general confidence gaining ground once more. This process will necessarily be a lengthy one, as the confidence of the broad public had during the time between the end of the War and the settlement of the reparations been deliberately undermined by Government and press, in the propaganda for obtaining the best possible terms. So thoroughly has public opinion been shaken in this respect that there is at present, with a few exceptions, no one in Germany who believes that the terms of the London ultimatum can be fulfilled at present or in the future. The first duty the present Government will have to perform is to abolish the system of pessimistic propaganda which had been poisoning the public mind, thereby checking enterprising spirit everywhere. A slight improvement in this respect is already noticeable, as is proved by news which recently have gone through the press, of a kind which only a few weeks ago would have been suppressed by the editor of every German journal. A striking instance of such news is the public admission that there exists a decided glut on the brown coal market for months, resulting in discharge of labor and shortening of working time. Although the hue and cry was chiefly for the lack of bituminous coal, the state of affairs on the brown coal market may be considered a gage of the real conditions.

Raising the Reparation Funds

The main question by which the country is now confronted is how to raise the tribute to be paid under the London ultimatum. That it cannot be done by the country's revenues is made evident by the returns published for the last revenue year, which runs from the 1st of April, 1920, to the 31st of March, 1921. According to these returns, the total revenue of the country was 73,000,000,000 marks, while the expenditure amounted to 89,600,000,000 marks, resulting in a deficit of 16,600,000,000 marks, which has to be balanced by public loans. In the current year the deficit is estimated at 30,000,000,000 marks, in which sum, there is, however, included a payment of 27,000,000,000 marks toward reparations. Import duty netted only 305,000,000 marks (paper), as against 721,500,000 gold marks in 1913, giving an indication of the extent of import in comparison with pre-war years. The coal tax produced 4,670,000,000 marks, the tax levied on business turnover 4,200,000,000 marks, and the export tax 2,230,000,000 marks.

The Government revenue is based upon a very elaborate scheme of levying, handled by an enormous staff of officials, the majority of which are new to their present occupation. This machinery is only slowly coming into its swing, but its progress has been marked by a steady increase of revenue. It is also to be expected that the state railroads, which have so far been sapping a good deal of the country's revenues, will again come on a paying basis, the rates for passenger and goods traffic having been raised up to 65 per cent, and economy is being enforced with increasing effectiveness. Still it is being recognized that there is no room for the billions of gold marks to be paid annually in the framework of the present taxation system. New taxes will have to be devised, and the Government is looking for the additional revenue required to that part of the population which is economically in the strongest position, i.e., the producers.

It has been said so often by almost everyone in authority that it has become a rigid principle that the country's strength and capability to cope with the reparation duties rests with production. The producers themselves, however, are at a loss to recognize how this principle will work in actual practice. That the production must be increased at an enormous rate to produce such values as are required is a matter of course. The present capacity of the whole industry is, so the foremost economists of the country assert, hardly adequate for the purpose. To increase it does not present such difficulties to the manufacturing world as does the marketing. Numerous and strong barriers are standing in the way of disposing of German products on foreign markets, quite apart from the present business dullness. To achieve the end in view it is commonly believed to be necessary that German products can be manufactured so cheaply that they will surmount all such barriers, and restore purchasing power.

One of the captains of German industry, expressing no doubt the opinion of most of his brethren, recently held out that the "discount of hatred"—a word coined for the margin by which German manufacturers felt themselves compelled to underbid foreign rivals—would have to be large enough to break with elementary force all obstacles artificially raised against German goods abroad. For carrying this out, only one way appears to be open to the majority of manufacturers, that is the extension of regulation working time, and the reduction of wages. The first instance of a step made in the latter direction is that of a large Western copper mining company, the Mansfeld Works, which have cancelled their present wage agreement, with a view to enforce reduced wages. The result of the strife which is bound to ensue is awaited with keen anxiety in the industry, as no doubt it is symptomatic. Without making an attempt at prophecy, it may be said that the experiment of the Mansfeld Work is premature, and open to failure.

The Return of Piece Work

The problem will no doubt soon be tackled from another end, of which signs are already perceptible, that is by the return to piece work. It must be remembered that after the revolution piece work was abolished throughout the country. Later on, however, it was reinstated, but only partly. All wage agreements existing provide that in the case of workmen accepting piece work they receive minimum wages, with the payment for piece work overriding. Although the result of this system is so far quite satisfactory, it does not produce the utmost efficiency now required. Manufacturers are as a rule quite prepared to give the workman an income which in the aggregate would be higher than his present pay, if it based purely on piece work. Under such circumstances the whole problem would appear to be quite simple, but it is nevertheless fraught with considerable difficulties. To attain the end in view, the industry will have to traverse a long and thorny road. The workman will not easily abandon what he believes to be one of the most valuable achievements of the revolution—a fixed income, and the abolishment of what he calls sweating practice. He may even be more amenable to the attempts at extending regulation time.

Negotiations between trade union leaders on the one side, employers' societies and government officials on the other side are actually being carried on, with the object to make stipulations for one or two hours' overtime. The basic conditions upon which the workmen are prepared to enter into such discussions are the fixation by law of the eight-hour working day, in order to guard against overtime automatically becoming part of the regulation time, and that the overtime work should only benefit the workmen on the one hand, and the country on the other, but under no circumstances capitalism. Whether anything will materialize soon from the negotiations is, at the present extent of unemployment, rather doubtful.

From all these schemes is peculiarly absent the problem of raising the production by improved mechanical facilities and better organization. The reason for this is that possibilities in this direction are hardly realized, much less admitted. One of the first persons in authority to admit them was Dr. Walter Rathenau, the president of the AEG (General Electric Company), as has been mentioned in the last letter of your Berlin correspondent. It transpires that Dr. Rathenau has been severely censured for this admission, but it is significant for the policy of the present Government that it has since then offered Rathenau the Ministry of Reconstruction. (At the time this is written it has not become known whether he has accepted.) In favor of Rathenau speaks the wonderful organization of the large enterprise he is presiding over, and his clear insight into all phases of the production process. Moreover, he is one of the few industrial leaders who is not closely leagued to the Rhenish-Westphalian iron and steel industry, which managed to obtain such predominating and not entirely wholesome influence in the administration of the country. A person of Rathenau's authority would indeed be needed to initiate progress in the direction mentioned.

Everything in Germany is now done through the manufacturers' organizations, which have managed to gain a strong position of authority over the individual manufacturer. These organizations are mostly indifferent—not to say in opposition—to further "mechanification" of labor, which is shown by the half-hearted way in which the "Committee for Economical Production" is treating such matters. The reason, of course, is the enormous amount of capital investments and work which a radical reformation of the production toward highest efficiency and economy would entail. A striking illustration of this attitude is the case of the coal mines of the Ruhr district, which stand in urgent need of new equipment. The cost of modernizing these mines, whereby their efficiency could be raised from 30 to 50 per cent, is estimated at 9,000,000,000 marks. It is a peculiar fact, and characteristic for the incoherency of mind prevailing throughout the country, that with the haggling of who is to bear the burden of this investment the mines are allowed to be run down, and the whole production to rest solely on the quantity of manual labor. At the same time enormous sums, far exceeding the amount required, are invested in public utility works, like the construction of inland waterways and hydro-electric power stations, schemes which will bear fruit only in a rather remote future.

Manufacturers Organizations

The whole production problem is, however, bound to be carried forward by sheer force of necessity. Hand in hand with the problem goes the movement for the liberation of the export from all fetters. This movement, which has been mentioned in these columns several times, is growing stronger every day. It is chiefly supported by the trade, while the producers' organizations are divided in their opinion. The latter are only unanimous with respect to the abolishment of the export tax, which has been levied up to now to an extent of from 2 to 10 per cent of the value of exported goods, and which it is argued cannot be allowed to continue as a separate item alongside of the export tax to be raised as a part of the reparation terms.

So far the decontrol movement has had the result that a number of products have been freed from export control, mostly however raw products, which is a peculiar fact, as the chief efforts are directed toward the decontrol of finished products. The resistance with regard to the latter mainly rests with the organizations of the manufacturers, which are fearing that upon decontrol an extensive underbidding will commence. The advocates of decontrol are arguing that the country should neglect for the time being all efforts to exact the best possible prices on foreign markets in favor of a large volume of exports. The question of prices should be left to the judgment of the individual exporter, who is now able to survey his own possibilities. Cases are frequent of official export offices compelling manufacturers to quote at prices which far exceed current quotations in foreign markets. It is a fact that the individual exporter is frequently better informed of foreign prices than the export offices, whose chief business it is to be conversant with them. The policy recommended by the free trade advocates amounts to dumping on a large scale, in the hope of stimulating consumption, and gaining a firm foothold on foreign markets.

No Business Revival Before Fall

The business situation remains utterly dull. The outlook for the next months to come is still very gloomy, and a revival is not hoped for until fall. A considerable step forward has been made by the Government issuing an assurance that the tax

raised in foreign countries on German products, which is to be paid from the purchase price, will be refunded to the German exporter. Under the stimulus of this assurance, business relations, especially with England, are being gathered up again where they had been dropped under the effects of the sanctions. The regulation mentioned is, however, of a transitory nature only. It is clear that the Government cannot go on to reimburse manufacturers from public revenues, and a way will have to be found for unburdening the tax on broader shoulders. In the meantime, a movement becomes noticeable mainly in the machine building and iron and steel industry to circumvent the export tax, by transferring part of their manufacturing into other countries. Austria for instance has lately been flooded with tentative offers for the purchase of factories, or of co-operation. Hungary also has been drawn into the circle of possibilities, and it is reported that Stinnes, who always seems to be the first on the field, has lately acquired the controlling interest of large Hungarian concerns, the Rima-Muranyer iron works, the Schlick-Nicholson machine factory, and of the shipbuilding works Ganz-Danubius.

Inquiries from abroad are coming in again in increasing numbers, a factor which is raising hopes. It is also expected that the sanctions will soon be cancelled, doing away with the customs barrier, which already has become a rather painful thorn in the flesh. From the industry in the Cologne district discharge of workmen and reduction of working time is reported in numerous cases. The Rhenish industries have formed a strong organization, with the object of balancing as much as possible the evil effects of the sanctions. Manufacturers of kindred products have formed combines, which are working in close conjunction. Most of these organizations have decided to bear the burden of the export tax from the occupied territory into the interior of Germany, in order to enable the industry to compete with that of the unoccupied part of the country.

Delays in Shipments

The customs barrier has become the operating field of extensive red-tape practice from the side of the Interallied customs organization as well as by German officialdom. The consequence is considerable delay of shipments, and the clogging of frontier stations. Although there is no duty levied on shipments coming from the occupied zone on the German side, an elaborate system has been established for controlling such shipments, with the object of keeping out undesirable foreign products, which might enter through the occupied territory. The opinion prevails in the Rhineland that it is the intention of the Interallied Commission to handle the sanctions with a view to detach the province more and more from the mother country, and to make it economically an independent unit—a policy which would have been ruinous to a large number of factories. The at first unbending attitude of the Rheinish industry has therefore in the course of time weakened consider ably, and the cancelling of the sanctions is looked forward to with growing impatience.

The situation of the industry in the interior has undergone very little change. Manifest signs of distress like in the Rhineland are absent, although unemployment is spreading further. The extent of the unemployment may be gaged by the publications of the National Ministry of Labor, which states that in April, 1921, the number of workers engaged in concerns badly employed has risen from 38 per cent in March to 43 per cent in April, while those engaged in works sufficiently employed had decreased from 30 to 28 per cent in the same time. Of two million metal workers, 10.2 per cent were working short hours. This percentage was at the middle of January 6 per cent, at the end of January 7.1 per cent, end of February 7.9 per cent, and end of March 8.3 per cent. In the metal industry, where business conditions are exceedingly depressed, only 2.6 per cent of the workers are engaged in works well employed, while in the case of 18.1 per cent the employment is satisfactory, and for 79.3 per cent, that is more than three-fourths of the total employed in this industry, the employment was reported to be bad. Shortening of working hours, and discharge of workmen are taking place in this industry in an increasing extent. With the sole exception of works with orders for the railroads, the drop of employment is general.

Railroad Material for Russia

In the iron and steel market business continues within narrow limits. Satisfactory demand is only reported for railroad material for German and Russian account. The decontrol of this market, resulting in heavy underbidding of the previous prices, has so far failed to act as a stimulus to buying. The same can be said of the foundry industry, where heavy reduction of prices also produced little result. An exception in this respect is only presented by the Berlin foundries, which so far have sufficient business on hand.

Little Machine Tool Building

In the machine building industry the demand has come to an almost complete standstill. Up to the middle of April, shortening of working hours and discharge of workmen has taken place in comparatively few cases, but they have increased at an alarming rate since the end of April. A number of machine tool works have lately discharged from 10 to 30 per cent of their workmen. Of 238,000 workmen employed in the machine building industry, more than three-fourths have at the end of April been engaged in works badly employed, and only in the case of 23 per cent was the employment reported to be fairly adequate. The number of unemployed in this industry is increasing in all parts of the country. Most pronounced is the business depression in the machine tool industry, which now forms one of the worst employed branches of the machine building industry. The situation of several works in this industry has become rather critical. This is evidenced by agents having been empowered to sell machines from stock "at any reasonable price."

It is rather astonishing to see how the majority of manufacturers are weathering this lull of business. The fact is that many of them have become more and more dependent on bank loans, and as private-owned concerns find less willing support from this side than joint-stock companies, reorganization of private-owned concerns into joint-stock companies is making increasing headway. In the machine tool industry, for instance, nearly all works of note have now been transformed into joint-stock companies, or are in the course of doing so.

The unemployment problem is under such circumstances causing the Government considerable concern. Communities and provinces are urged to provide emergency work, mostly in the building line. Many schemes have been devised for this purpose, but as the central Government has withdrawn financial support, and leaves the burden of financing to the exchequers of the municipalities and provinces, slow progress is being made in this direction. This has lately caused the Government to devote attention to provide facilities for the unemployed to find vacancies. A bill has been submitted to the Reichstag for abolishing private employment agencies, and handling the business through public organizations. This scheme is causing strong opposition in the industry, as it is feared that red tape must produce more harm than good. Besides, the bill contains several clauses which raise the suspicion that pressure can and would be exercised for employing men without sufficient qualifications. The arguments offered against the scheme are based upon bad experiences made in one German province, where the provincial Government has already monopolized the employment agencies, with absolutely negative result.

Army Ordnance Association Establishes New York Post

Over two hundred members of the Army Ordnance Association and former ordnance officers met in the Engineering Societies Building on June 15th and formed the New York Post, with headquarters at Governors Island. The new post will be the central organization for the Second Corps area.

General C. C. Williams, Chief of Ordnance, opened the meeting and called attention to the need for ordnance reserve officers and for a post to carry out the ordnance organization plans of the General Staff. He then turned the meeting over to the temporary chairman, Guy E. Tripp.

Mr. Tripp introduced Major Brett, Ordnance assistant in the office of the Secretary of War, who described in outline the plans of the General Staff for the organization of the Ordnance Department under the act of June, 1920. Major Brett stated that the work had been divided into three sections: engineering, design and preparation of plans; organization for military and industrial purposes; and production and plans for production. Funds are available for the first of these and the organization scheme for field duty has been completed. The greater part of the forces consists of the organized reserve and the need, therefore, is for some 5,000 reserve officers, of whom less than half have been commissioned. Looking to the future when the present trained officers will have gone back to civil life it seems that the only source of replacement is the R.O.T.C. Unit in the engineering school. Such units exist at Massachusetts Tech., Yale, Cornell and Wisconsin.

The chairman then asked Major Coombs to form a resolutions committee and Colonel Morris a nominating committee, the committees to withdraw and present recommendations. The resolutions committee brought in a report suggesting a form of organization which was adopted and the following officers were chosen to serve for the first year: President, Guy E. Tripp; 1st Vice-president, Colonel Warren; 2d Vice-president, Major Maish; Secretary-Treasurer, Captain Wilkins. Committees on programs, membership, military preparedness and industrial preparedness were also appointed.

Philadelphia Foremen Meet

About 700 foremen and forewomen have attended instruction classes under the direction of the Philadelphia Association for the Discussion of Employment Problems during the last year.

The foremen's group is open to men and women employed in a supervisory capacity by any firm that is a member of the association. In addition to the regular weekly classes, meetings for the entire group are held monthly.

Membership now consists of 102 manufacturing and commercial companies, representing about fifty different industries and businesses here. This membership totals 5,000 individuals, including employers and employees, about 20 per cent of them women.

The two other sections include the managerial group, including presidents, managers, engineers and superintendents, and the personnel group, consisting of personnel supervisors, employment managers, doctors and service workers.

Charles E. Brinley, of the American Pulley Co., has been elected president, succeeding A. E. Chevalier, who retains his position on the Executive Committee. Prof. Joseph H. Willits, of the University of Pennsylvania, was elected vice-president; John M. Williams, of the Fayette R. Plumb Co., secretary; W. M. C. Kimber, of Leeds & Northrup, treasurer, and A. J. Churchill is executive secretary.

India's Production and Consumption of Coal

By ALEXANDER W. WEDDELL
(Consul General Calcutta)

According to the recently issued report of the Department of Statistics ,India, on the production and consumption of coal for 1919, the country's total production in that year amounted to 22,630,000 tons, of which 98.3 per cent was obtained from the Gondwana system of strata (chiefly composed of sandstone and shales deposited in fresh water and by river). British Provinces are credited with the production of 21,770,000 tons, of which Bihar and Orissa produced 15,120,000 tons and Bengal 5,780,000 tons. Thus the output of these two Provinces alone amounted to 92.5 per cent of India's total, 87 per cent of the total being derived from the two fields in Damodar Valley, Jherria producing 12,146,000 tons and Raniganj producing 6,815,000 tons. The Native States produced only 860,000 tons, of which 660,000 tons is credeited to Hyderabad.

There are over 200 joint-stock coal companies at work in India, whose combined authorized capital totaled 140,300,000 rupees with paid-up capital of 86,800,000 rupees and debentures issued to the extent of 2,400,000 rupees.

The report estimates that the consumption of the total available supply of 1919 was distributed about as follows: Railroads, 27.3 per cent; bunker coal and Admiralty and Royal Indian Marine shipping accounts, 10.7 per cent; iron and brass foundries, 5.7 per cent; cotton mills, 4.7 per cent; jute mills, 4 per cent; consumption at collieries and wastage, 12.2 per cent; and other forms of industrial and domestic consumption, 35.4 per cent.

Some coal was imported but this only amounted to 38,180 tons in 1920, while in the same year the exports were 679,769 tons.

Reclaiming of Foundry Sands

A co-operative study of the problems encountered in the reclaiming of foundry sands is to be made by the Bureau of Mines and the American Foundrymen's Association.

Business Conditions as the Big Banks of the Country See Them

The National City Bank's Observations on Industry, Capital and Interest

The industrial situation in this country continues to be uneven and on the whole without pronounced development. The industries making goods of common consumption and in which depression has existed for practically a full year, such as the manufacture of clothing and shoes, have experienced a revival, old stocks having been depleted to a point where dealers are obliged to buy to supply current trade. Hides and leather are in better demand and bringing better prices. Wool purchases by manufacturers have not been in proportion to the orders for cloth on their books, but they have been buying continuously and the tone of the market has been better, although prices are not much higher.

The iron and steel industry, which in past times has been considered the best index of general business conditions, is at the lowest level of production in many years, with no trustworthy signs of improvement aside from the general factors of the situation named above. It is waiting on better net revenues for the railroads, a revival of construction work, and more general prosperity.

Credit Conditions

Although the volume of bank credit still is much above normal proportions it has been largely reduced since the first of the year, and the strain at the centers is much reduced. Apprehensions as to unfavorable developments in the credit situation as a whole are no longer seriously felt. The money markets are easing slightly, as bank loans are reduced, reserve bank rates in this country having been generally reduced from ½ to 1 per cent during the past month. The Bank of England rate has been reduced from 7 to 6½, and the Bank of Sweden rate from 7½ to 7. The Norwegian rate is 7 and the Danish rate 6½. The security markets have given a good account of themselves, the flotations in this country having been very large and well taken. In London the financial markets have been steady, notwithstanding the grave industrial situation.

Interbank borrowing among the Reserve banks has increased during the past month, the banks directly serving the chief agricultural districts requiring aid to enable them to meet the legitimate demands arising from the activities of the spring season. This has been expected and is necessary. Credit must be found to carry on the productive processes of the country. Obviously every section and interest is served by so doing. There will be no prosperity for "big business" or little business of any kind unless production goes on—little freight for the railroads, trade for the cities, or deposits for the banks, if the crops were not forthcoming.

The Scarcity of Capital

During the war the whole world violated economic principles, centering all thought and effort upon winning the war. Credit was created without stint, and interest rates kept artificially low. Instead of restricting private consumption in order to release productive capacity to the government and to supply the government with real capital, we undertook to provide the government with purchasing power through the private use of bank credit, on a great scale. We borrowed as individuals and turned the proceeds over to the government. Probably no other course was practicable, but this inflation of credit resulted in the great rise of wages and prices. We got away from all standards of value. Finally, when an effort was made by the bankers to stop the tide of inflation, interest rates inevitably went up, and have remained up, although now softening a little, as progress is made in restoring normal conditions between capital and credit.

During our Civil War, when the Government paid its expenses largely by printing the greenbacks, the greenbacks depreciated in value and were finally brought to par with gold in 1879. This time our paper money was kept at par with gold, but the purchasing power of our whole body of money, gold included, depreciated almost as much as the greenbacks did in their day. Federal Reserve credit was regarded as good as gold, but the profusion with which it was issued had the effect of depreciating gold, as any substitute which is "just as good" will depreciate the value of the thing it imitates.

Interest Rates for Capital

Interest rates cannot be regulated arbitrarily; they must correspond to the relation between the supply of available capital and the demand for it. That has been affected by the war, and is still affected by taxation, high cost of living, unremunerative returns upon great sums of capital invested in railroads and public utilities, credits granted to Europe, and finally the industrial disorganization which is rendering business enterprises unprofitable and tying up large amounts of capital in frozen assets. Interest rates will come down as new capital is accumulated, and that will be promoted by a general understanding of the fact that the entire community is served by such accumulations, no matter who owns them. There is no remedy for a scarcity of capital but more capital.

The Money Question

Nine-tenths of the erroneous thinking about money is due to confusing money as a medium of exchange with capital. Money is a convenience in effecting the exchanges but it does not take the place of capital. The money question always has been a subject of controversy, and it is not easily elucidated in all its details, but there are certain broad propositions which most people are able to grasp, and which when agreed to will dispose of many of the most plausible fallacies. It is a safe rule in the business world not to try to get something for nothing, and in the world of applied science not to try to get more out of any combination than the sum of all that is put into it. By the same reasoning it is safe to conclude that a people cannot make themselves rich by printing money or by any other scheme for making credit take the place of capital. There is a hole in every such proposition somewhere.

War Prosperity a Delusion

It does not stand to reason that the unproductive expenditures which the United States made on the war could be the basis of a higher permanent level of prosperity than it had ever known before. Real prosperity comes by an increase of the supply of wealth which one way or another contributes to the well-being of the population, and the expenditures upon the war do not come under this description. And yet a great many people who considered that they were very prosperous during the war and in the two years following are convinced that that state of prosperity might have continued indefinitely if the bankers had not arbitrarily restricted the manufacture of credit. They do not see that a settlement day need ever have come, or that a reaction was inevitable.

Taking the country as a whole the war-time prosperity was a delusion. Those who actually improved their position did so at the expense of others. Normal relations were violently disturbed, with the result that some were gainers while others were losers, and many were temporarily deceived into thinking themselves gainers when in fact they were not. A good many people were consuming principal when they thought they were living on income, and many were happy and wasteful under conditions which could not possibly be lasting. The people who gained unearned profits by the sudden rise of prices should have known that such a disturbance of normal conditions involved the probability of a reverse movement, and all those whose incomes increased faster than their accustomed expenditures should have known that this was a temporary gratuity at the expense of the letter carriers, school teachers and millions of other people whose expenditures increased more than their incomes.

The economic law eventually levels out all such inequalities and restores the normal balance. The people who at first had the best of the disturbance are the chief complainants now.

The Cleveland Trust Company Sees Basis for Confidence in Trade Revival

Apparent price stabilization of many fundamental commodities at a level upon which trading can be confidently resumed is the outstanding business development of the past month, says the Cleveland Trust Co. in its midmonth Business Bulletin for June.

"These are commodities that have world-wide markets and they were among the first to enter upon the long price decline that has continued for more than a year and has been the most severe in our economic history," says the bank. "Now there is increasing evidence that a turning point has come and that we shall see in the next few weeks and months a stabilization in the values of such products as these, while the prices for other products continue to fall in line with them.

"As confidence in price develops in one line after another the industries affected take a renewed activity, and as each industry increases its activities it helps other industries. Such improvements are already noticeable in the cases of leather, silk, cotton, wool, copper, lead, flour, cement and meat."

Constructive Developments

Other constructive developments of the month pointed out by the bank include decreasing unemployment in Cleveland, gains in new building, prospects for improvement in the iron and steel industry, and the receding number of commercial insolvencies. It is observed, however, that business failures may increase when trade revival begins. This is because some firms, able to bridge the present crisis, may not be strong enough to survive active competition.

"Offsetting the depressing factors in the immediate outlook of the steel industry are a number of constructive influences. These include the improvement in the railroad situation, the better prospects for the farmer, the rising tide of building construction, and the fact that the extreme slump in steel production is out of proportion to the smaller decline in the general level of business activities.

"Each of these factors should exert an important bearing upon developments in the steel industry and, combined, they offer the hope that present plant operations of from 25 per cent to 30 per cent will be raised as high as 50 per cent before the end of the year.

"The one bright spot of activity in the coal industry is located in the regions supplying fuel for lake shipments to the Northwest. Operations in these districts are at about 70 per cent of capacity compared with 45 per cent for the country as a whole.

"During the past month security prices have declined under the depressing influence of reports of low earnings and cutting or passing of dividends. This sort of decline in security values has virtually been a feature of the later stages of previous business depressions. The average price of 10 Cleveland industrial stocks by June 10 had fallen three points under the extreme low reached in December."

Exposition at Portland, Oregon

Another step has been taken by way of preparation for the International Exposition to be held in Portland, Ore., in 1925. The Senate has passed a bill authorizing the President to invite foreign countries to participate in the exposition. The exposition is intended to celebrate the completion of the transcontinental and Pacific highways, the centennial of the invention of the electro-magnet and to exemplify the development of hydro-electric energy.

Meeting of the Purchase and Stores Division of the American Railroad Association

The annual meeting of the Purchase and Stores division, known as Division 6, of the American Railroad Association, was held in the Blackstone Hotel, Chicago, on June 9 to 11, 1921. There seemed to be a general feeling that the meetings were in a manner interrupted, due to demands of other pressing railroad problems upon the time of some of the officials taking part in the meeting. However, the interruptions did not prevent the presentation of a number of committee reports and papers of more than passing interest to officials engaged in this branch of the railroad industry.

The general committee of Division 6 reported on a plan covering the organization of the Purchase and Stores division of railroad service. The committee called attention to the outstanding fact that the maintenance of necessary stocks of materials and supplies for railroad needs involved the investment of 35 per cent of the gross earnings of the road. The care and custody of the material represented by this investment, as well as the necessity for a more effective and systematic means of controlling it than has hitherto generally existed on railroads, should be recognized as of sufficient importance to demand the best effort of a department organized exclusively for this service. The officers and employees of such a department must, in all respects, rank with officers and employees of other operating departments, both in the divisional and general organization. Recommendations in regard to the organization of these departments were made and from past experience it has indicated that the roads might thereby substantially reduce a portion of their operating expenses. Other recommendations included that of organizing on all railroads a purchasing department that shall be in charge of a general purchasing agent. He should buy all material and supplies of every description required for use by the railroad. The stores department shall be in charge of a general storekeeper, who shall be responsible for the custody, care and distribution of all materials not actually used. He shall have direct charge of all material not in actual use, including scrap and second-hand material and the reclaiming of usable material. In his charge will be the primary accounting for the receipt and disbursement of all material.

Another recommendation was that there should be the closest co-operation between the purchasing and stores department, and that both these branches of the service should be under the control of a single executive officer in exclusive charge of supplies. This form of organization has the advantage of concentrating responsibility and authority over unused material in the hands of a single department which can be held to strict accountability.

The third recommendation was for the adoption of a uniform method of accounting for materials and supplies by all railroads and suggested that this shall be in accordance with the standard material classification prepared and recommended by the former Railway Storekeepers' Association.

Unit Piling for Counting

J. A. Stuart, general storekeeper, C. B. & Q. R.R., reported on the subject of "Unit Piling for Counting." His paper was much to the point and some of the matters suggested there may be just as valuably applied in the manufacturing field of storekeeping as they are useful in railroad work. He said that to keep stock and have it available when needed, and at the same time to do this with a minimum investment, is the primary work of a storekeeper; in other words, to keep a sufficient stock and yet not keep more than is sufficient. Anything which will help us to improve our present stockkeeping methods or which will enable us to get as good service as we are getting now at a lower cost, is desirable.

On the subject piling in units he said that when material is being placed in stock a certain number of pieces are designated as a unit and as the material is stored it is separated so that each unit contains the designated number of pieces and each unit is in some way separated from the other units of the same material and stands out alone so that, in counting the stock, the stockman counts the units and not the items. For example: If machine bolts were piled in units of one hundred each the stockman would count the units and would not attempt to count the bolts. If the pile contained eight units he would count the units and know he had 800 bolts. If the units were properly separated it would hardly be necessary even to count the units for just in the time it would take him to look at the pile, he would also be able to see that the eight units contained 800 bolts. In case one of the units should be broken so that there were eight full units and part of the ninth, it would, of course, be necessary to count the number of bolts in the broken unit in order to get an accurate count of the pile.

In the same way a great many other items, in fact, practically all items of storehouse material may be piled in units.

A plan of far-reaching importance was that reported by the joint committee of the Mechanical and Purchase and Stores Divisions of the association, concerning the joint inspection of standard material. The plans discussed included first, a regional plan whereby the roads with inspection forces would handle all inspection for other roads in certain regions. Second, by a central bureau of inspection organized and operated by the association but without testing laboratories. It was decided that with either plan the roads interested must necessarily agree on uniform material specifications which would naturally be those of the association covering such standard materials as air-brake and signal hose, air coupling gaskets, couplers and coupler parts, axles, springs, wheels, side frames, bolsters, brake beams and journal bearings. The majority of the committee was of the opinion that the regional plan of inspection by certain roads for others would not work out satisfactorily, primarily because of sources of material are largely confined to a restricted area and the burden would fall upon a comparatively few roads operating in that area. These roads would have to increase their inspection and testing facilities, and, further, such an increase in their work might result in discrimination in favor of their own material under certain conditions of pressure for material.

The Central Bureau of Inspection under the control of the association appeared to the committee to possess the greatest practical value, provided always that the railroads now purchasing material without inspection could be brought into the organization and made to stand their pro rata share of the expense. The manager of such a bureau should have unquestioned authority to rule on all disputes between his inspectors and manufacturers, and there should be no appeal from his decision. In order to complete the plan the roads now inspecting their own standard parts would have to agree to turn this part of their work over to the Central Bureau and stand their share of the expense in addition to continuing their inspection forces on other material. As far as certain large railroads are concerned this would seem to indicate additional expense without benefit, but experience may prove otherwise.

The committee on the reclamation of material reported that they had been unable to locate any new processes as suitable for reclamation purposes other than those generally covered in previous reports. It is now noticeable that all railroads are reclaiming very closely. Investigations of scrap disposed of by sale shows a considerable improvement over previous years. One of the new features of reclamation and one which is being developed rapidly is the welding of materials by the electric or oxyacetylene process of welding. The success of these processes depends to a large extent upon having competent operators and requires constant personal supervision on the part of the officer in charge. It is recommended that attention be paid to facilities for pre-heating for welding, as this important feature at a small cost frequently lessens the cost of welding. The pre-heating furnaces are also of a great deal of value in annealing work after it has been welded, thus preventing fractures from stresses caused by expansion and contraction.

The meeting of the mechanical section was postponed to June 29th and 30th and transferred from Hotel Drake to Hotel Blackstone.

Iron in Manchuria

The Peking Government has sanctioned the working of the iron deposits in Kungchanling, under Chino-Japanese joint management. Permission to work the deposits was originally granted by the provincial authorities in 1916, but the final sanction by the Peking authorities was withheld until recently. An analysis of the ore shows that it contains 71.20 per cent of iron; 0.32 per cent of silicic acid; 0.024 per cent of sulphur; and 0.017 per cent of phosphorous. The deposits extend over a very large area and it is calculated that not less than 200,000,000 tons are available.

Washington Notes

By PAUL WOOTON
(Washington Correspondent

Every effort is to be made to secure the prompt enactment by Congress of Senator Stanley's bill amending the revised statutes relative to patents which will require manufacture within continental United States of any article covered by a patent granted a foreigner.

In recommending the legislation to the Senate, the committee on patents pointed out that the War Department noticed in April that a large number of applications of patents were being filed by Germans. Many of these have been assigned to various German companies, including that of Frederick Krupps of Essen. An investigation by the War Department of 228 of these applications which related to ordnance disclosed the fact that all were assigned to the Krupps company. Of the 228 applications it was found that 26 related to artillery fire-control devices, 18 to electric-control apparatus, 9 to fuses for projectiles, 6 to gas engines and appurtenances, two to gyroscopes, 17 to guns and their appurtenances, 3 to metals and processes for producing metals, 10 to naval firing-control devices, three to projectiles, 14 to railroad artillery, 11 to self-discharging wagons (railroad cars and other forms of wagons) and 24 to tools and apparatus for ordnance production.

The Secretary of War approves the legislation in that it prevents foreigners from securing United States patents for the sole purpose of protecting them against American manufacture of the articles covered by such patents. Secretary Weeks points out that under the present law foreigners enjoy the same protection and monopoly as to patent rights as do American citizens. In cases where patented articles are fully protected by the United States patents, it is of little consequence how high an impoft duty is placed on articles manufactured under such patents in foreign countries since they are not manufactured in the United States and are necessary to the carrying on of our industries and must be imported regardless of the high tariff.

Secretary Weeks believes that the Stanley bill insures the foreign holder of the patent a reasonable return on his invention and at the same time insures the United States a domestic source of the product.

Motors Replace Horses

The extent to which horses are being displaced by motor vehicles is shown by the report of the Bureau of Census covering the number of horses in various cities. The decrease in the number of horses in New York in 1920 as compared to 1910 was 40 per cent. The percentage of decrease in certain other cities is as follows: Chicago, 44 per cent; Boston, 43 per cent; Cincinnati, 36 per cent; Cleveland, 30 per cent; Pittsburgh, 46 per cent; Baltimore, 48 per cent, and Philadelphia, 38 per cent.

Shell Steel Sold

The Ordnance Salvage Board has accepted the bid of Max Soloman of Pittsburgh for 21,000 tons of shell steel and shell steel forgings. The amount involved is $217,251. Mr. Soloman was the highest of 15 bidders.

Ordnance Claims Settled

During March, April and May the War Department adjusted 33 Ordnance claims involving the payment to private manufacturers of $7,451,964.86. There still are 113 claims awaiting settlement. These claims aggregate $34,990,238.38.

American Locomotive Co. Orders Boring Mills

The American Locomotive Co. has recently placed an order for six 90-inch boring mills for work in the firm's various plants. The machines are being built by the Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio, which concern co-operated in the development of the mill with the Dale Machinery Co., 54-60 Lafayette St., New York City and 541-7 W. Washington Blvd., Chicago, Ill.

The design of the machine conforms to the standard specifications of the American Locomotive Co. for a heavy-duty wheel boring and turning mill of the movable cross-rail type. The machine will be belt driven by an individual variable-speed motor, and a disk clutch provided in the drive. A separate motor will be used for moving the cross rail, which can be raised 46 in. above the table.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Lathe, Geared-Head, "Sterling"

Shepard Lathe Co., Rising Sun, Ind.

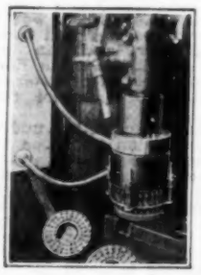
"American Machinist," March 17, 1921

The "Sterling" lathe, previously described on page 1061, Vol. 50, of the American Machinist, is now made with a completely inclosed, geared head and with a single-pulley drive. It can be driven from a countershaft or furnished with a foot-power drive. In the illustration it is shown equipped with an individual motor mounted on top of the headstock and belted to the pulley. The motor is small enough to be driven by current from an ordinary lighting circuit, without additional power wiring or control. The lathe can be furnished with either a plain or a gap bed, and with standard or bench legs. The machine is said to be especially adapted for use in garages, training schools and repair shops, and for experimental work and light manufacturing. Two of its features are stated to be the facts that there are no shifting belts nor shifting gears.

Drilling Head, Multiple-Spindle, "Newmaneo"

Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio

"American Machinist," March 17, 1921

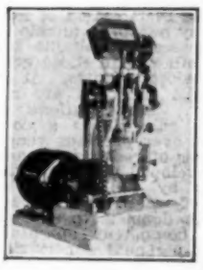


The device is intended for the drilling simultaneously of a large number of small holes, the head shown drilling 69 holes in a gas-burner casting. It is provided with a water jacket, through which water is circulated in order to cool the head and to keep both it and the drills from overheating. The device is intended for use upon a standard drilling machine, but can be built to suit any particular machine and also to meet the individual requirements of the work. It should be noted that the lower ends of the drills are steadied by means of a plate provided with hardened bushings, the plate being so fastened in position that it can be pushed close to the head as the drills advance into the work.

Testing Machine, Impact, Continuous and Alternating

Pittsburgh Instrument and Machine Co., 40 Water St., Pittsburgh, Pa.

"American Machinist," March 17, 1921

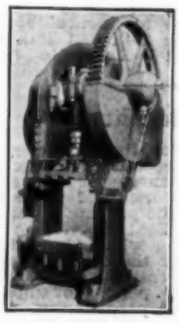


The machine is intended for the testing of metals for fatigue and impact fatigue, the action conforming closely to the actual working conditions of metals subjected to repeated shocks and stresses. The piece rests on two bearings, so that the point of the ram is central with the notched part. A feeding attachment, run by the motor, turns the specimen halfway around between each blow, for the so-called "alternating" test, or, by means of a special attachment, through 1/25 of a revolution for the "continuous" test. The machine delivers about 85 to 100 blows per minute. The ram is raised by a cam and then allowed to fall on the test piece. An electric motor, driving through a worm and gear, furnishes the necessary power. As soon as the test piece breaks, the machine stops.

Press, Trimming

Marsillon Foundry and Machine Co., Massillon, Ohio

"American Machinist," March 17, 1921

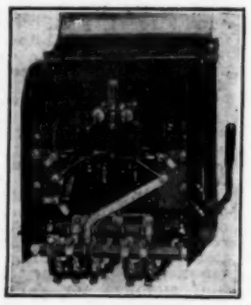


All clutch parts are inclosed and run in an oil bath. The clutch jaws are hardened steel and can be replaced without removing the gear. The clutch body has a square hole that slides on a squared portion of the shaft. The clutch can not repeat and a second stroke requires a full series of motions of the tripping lever. The main frame is made of semi-steel castings with legs cast integral. All main gears and pinions are of open-hearth steel with cut gear teeth. The press is made in suitable sizes, to trim forgings up to the maximum capacity of any drop hammer. A small outboard shear is provided at the flywheel side of the machine. The press is made either for belt drive, or with a platform for mounting the motor at the top of the frame and in the rear, so that the motor can be belted directly to the flywheel.

Starter, Auto-Transformer, Induction-Motor

Cutler-Hammer Manufacturing Co., Milwaukee, Wis.

"American Machinist," March 17, 1921

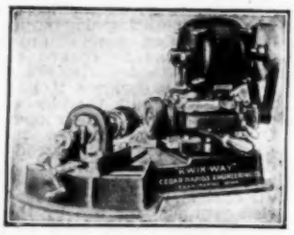


The starter is for standard squirrel-cage induction motors. The device consists of two auto-transformers, commutating mechanism, low-voltage release and duplex overload relay, all enclosed in a sheet-metal case with the operating lever outside. The case is reinforced with angle iron, and has a hinged cover which can be lifted, as shown, to expose the transformers and relay. The transformers and case are carried directly on the supporting brackets and may be mounted on the wall or switchboard. The oil-immersed commutating mechanism is placed at the bottom of the case and may be exposed for inspection. The starters are made in various sizes for the operation of two or three-phase induction motors rated between 5 and 100 hp., on standard commercial voltages between 110 and 2,200 and at frequencies of 60, 50, 40, 33 and 25 cycles per sec.

Valve-Facing Machine, "Kwik-Way"

Cedar Rapids Engineering Co., 902 North 17th St., Cedar Rapids, Iowa

"American Machinist," March 17, 1921

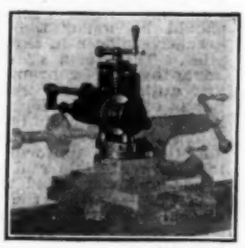


The device is intended for the purpose of refacing automotive valves, preparatory to grinding them with a grinding compound in place in the motor, as is the usual practice. It is claimed that by this method, but very little fine grinding with compound need be done with the valves in place. The valve is held by means of a chuck, and is rotated while in contact with the abrasive wheel. The spindle of the grinding wheel runs in ball bearings. It is stated that the chuck which holds the valve is capable of centering it, even though the stem be worn. Both the grinding wheel shaft and the chuck shaft are mounted on sliding carriages. The angle of the face ground upon the valve can be varied from 25 to 65 deg. The machine can accommodate valves having heads up to 3 in. and stems up to ½ in. in diameter.

Attachment, Milling and Grinding, Bench Lathe

A. F. Robbins Co., 85 Moody St., Waltham, Mass.

"American Machinist," March 17, 1921

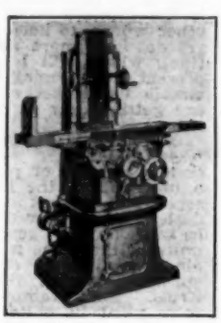


This combination adjustable milling and grinding attachment is intended for use on bench or other small lathes, for the purpose of performing small milling or grinding operations without removing the work from its mounting on the faceplate or in the spindle of the lathe. The stationary base attaches to the toolblock of the lathe by means of two flush-head screws. The device swivels upon a central stud rising from the stationary base, being held and secured thereto by a quick-acting clamp. The spindle-carrying member is arranged to slide vertically upon two pillars set into the swiveling base and tied together at the top by a rigid crossbar. Spindles for carrying various kinds of milling cutters and grinding wheels are provided. Provision is made in the vertically sliding member to insert an overarm, by which the outer end of the cutter spindle can be held rigid.

Grinding Machine, Surface, Vertical-Spindle, No. 3

Abrasive Machine Tool Co., East Providence, R. I.

"American Machinist," March 17, 1921



The tool is intended for small work, both in the toolroom and on regular production, being adapted to the squaring of the ends of shafts held on centers, the surfacing of small pieces held on magnetic chucks, and especially for the resharpening of pilot dies. The machine has a capacity of 22 in. longitudinal feed, 8 in. transverse feed, both automatic, and 10 in. hand vertical adjustment. The wheel spindle is carried on ball bearings and all of the high-speed shafts run on ball bearings. Wheels up to 5 in. in diameter can be used. All belts are enclosed, also the moving parts, so that the safety of the operator is promoted. The machine can be equipped with either a countershaft or a concealed motor drive. Provision is made for the use of water, so that wet grinding can be done.

Clip, paste on 3 x 5-in. cards and file as desired

Business Items

The Markwood Motor Co. has increased its capacity by moving to 1015½ East Capital Ave., Springfield, Ill. Machinery is to be installed and manufacture begun at an early date.

The Hydro Appliances Ltd., with $200,000 capital, has been organized at Port Robinson, Ont., Canada, to manufacture household electrical appliances.

The Ford Motor Co. will erect a $400,000 assembling plant in Hamilton, Ohio, with an output of 30,000 cars yearly. Cincinnati and Columbus plants will be merged and moved to Hamilton to obtain lower freight rates, it is said.

The Sandusky Foundry and Machine Co. has purchased adjoining properties which include dockage, to take care of their business, both present and future, and for which new machinery has been installed.

The Durant Motors announce that a new factory will be built at Oakland, Cal., to handle their Pacific coast business. This will be known as the Durant Motor Co., of California. Construction is scheduled to begin at once.

The Chicago sales offices of the New Departure Mfg. Co. have been removed from 2721 South Michigan Ave. to the Peoples Gas Building, 122 South Michigan Ave.

The Greenfield Tap and Die Corporation has purchased the entire capital stock of the Greenfield Machine Company, of Greenfield, and also of the Morgan Grinder Co., of Worcester, Mass. The purchasers will continue to operate both plants in their present location, although it is expected that the Worcester plant will be eventually closed. The organization of both plants remains the same with E. F. Smith president and Joseph G. Stevens treasurer of the former, and Raph L. Morgan president, L. M. Crittsinger treasurer, and Charles E. Hildreth general manager of the latter.

The Electric Machinery Mfg. Co., with a capital of $1,000,000, has been formed to take over the business of the old Electric Machinery Co., both of Minneapolis. The new president is Silas McClure, who bought the old concern from the receiver. Other officers include C. T. Jaffray, president of the First National Bank, E. W. Decker, of the Northwestern Bank, S. V. Wood, of the Minneapolis Electric Steel Castings Co., and E. W. Backus, of the Backus-Brooks Lumber Co. They will manufacture electrical devices as before but on a much larger scale.

The American Valve and Tank Co., of Delaware, will erect a plant in Indianapolis, Ind., and production is hoped for within three months.

Peter A. Frasse Co., 417 Canal St., New York, has been appointed sole agent for the Rivett products, made by the Rivett Lathe and Grinder Co., of Boston, Mass.

The W. H. Phelps Co., of Springfield, Mass., has been organized and incorporated with a capital stock of $750,000 to engage in the manufacture of chains, etc. The officers of the company are president, Wendell P. Phelps; and treasurer, Henry S. Wright, both of Springfield, Mass.

The George E. Lavietes Co., of New Haven, Conn., has recently been organized and incorporated with a capital stock of $50,000 to engage in the manufacture of hardware, etc. The incorporators are George E. Lavietes and M. Lavietes, and Emmanuel Thorner, all of New Haven.

The Rockville Iron Foundry Co., of Rockville, Conn., has been recently incorporated under the laws of the State of Connecticut. The capital stock is $50,000 and the incorporators are H. B. Murliess and S. Murliess, both of Rockville, and Andrew L. McCarthy, of Hartford. The concern has a plant on East Main St., Rockville.

The Kay Manufacturing Co. has been organized in South Norwalk, Conn., with George A. Kay as president, Lawrence F. Whitney as secretary and Clinton C. Hubbel as treasurer. The company is incorporated under the laws of the State of Connecticut to do a general manufacturing and sales business, but is at present handling only the Whitney free-floating shaft coupling.

Personals

S. B. Chase has recently joined the western sales division of the Heald Machine Co., Worcester, Mass., manufacturers of grinders and magnetic chucks, etc. Mr. Chase was formerly connected with the Waltham Wheel Co., Waltham, Mass., manufacturers of abrasive wheels, etc.

Oskar Kylin, who for the last five years has been chief engineer and a member of the executive board of the Foster Machine Co., Elkhart, Ind., has been appointed General Sales Manager, in addition to his other duties.

Robert S. Gans, in charge of sales and development of new products for the Raymond Engineering Corporation, New York, has been elected vice-president of that organization.

W. Barton Eddison, inventor of the jet entraining apparatus of the Surface Combustion Co., has been awarded the Edward Longstreth Medal of Merit by the Franklin Institute.

Colonel Washington A. Roebling, who was the engineer in charge of construction of the Brooklyn Bridge, and who recently observed his 84th birthday, has been elected to the presidency of the John A. Roebling Sons Co. He succeeds his nephew, the late Karl G. Roebling.

W. L. Neff, formerly with the New York office of the Brown & Sharpe Mfg. Co., is now the New York representative of the Davenport Machine Tool Co., of Rochester, N. Y.

Alexander B. C. Hardy, for four years president of the Waterloo Carriage Company, was elected last week president and general manager of the Olds Motor Works, Lansing, Mich. Recently he was made a member of the General Motors Corporation committee as its director of outside concerns.

W. E. Corey, chairman of the Board of the Midvale Steel and Ordnance Co., has been elected a director and a member of the Executive Committee of the International Truck Co., replacing Ambrose Moorell, deceased.

Warren F. Kendrick has left the employ of the Ford Motor Company as designing engineer to become sales engineer for the Griscom-Russell Co., Chicago, Ill.

M. E. Peck has been elected Secretary and assistant Treasurer of the Terminal Engineering Co., Inc., New York.

J. F. McGonigal, Mechanical Engineer, formerly of the Foamite Company and J. H. Potter, Mechanical Engineer, a graduate of New York University, have joined the Terminal Engineering Co., Inc., New York. M. E. Lyle for many years with the Columbia Graphaphone Company has been elected a Vice-President of the Terminal Engineering Co., Inc., New York and is directly responsible for new business.

Th. H. Nakken, E. E., of Rotterdam, Holland, is arriving Saturday on the S. S. "Rotterdam." Mr. Nakken is well known in the Netherlands for his research work and experiments in the field of transferring light into electric current. Mr. Nakken is coming to America to study the latest developments in this field and also to purchase additional laboratory equipment. His experiments thus far have been confined to automatic telephone exchanges, telegraphing pictures and entire letters instead of words, and in photographing sound, which is of great importance in the moving picture field. His headquarters while in America will be at 44 Beaver St., care of Alliance Transportation Co.

Bombing Tests

A special news article describing the bombing tests to be conducted by naval aviators on June 21, will appear in the American Machinist. The Washington correspondent of the American Machinist has been invited by the Secretary of the Navy to witness the bombing experiments against former German warships.

Obituary

William A. Jones, president of the W. A. Jones Foundry and Machine Co., died on May 30th.

Edward F. Cooper, sales manager of the Disston Saw Works, died suddenly on June 10th in a room at the Manufacturers Club in Philadelphia. Mr. Cooper was 63 years old and had been associated with the Disstons for many years.

A. C. Loomis, aged 59, died on June 10th at his home in West Orange, N. J. He had been connected for 31 years with the Edison industries, and was engaged in experimental work in the phonograph department at the time of his death.

William Browne Cogswell, founder of the Solvay Process Co., died on June 7, at the age of 86. Primarily a civil and mining engineer, he was always a geologist and chemist. The combination made it possible to induce the Belgian Solvays to sanction the expansion of their manufacturing process to America, at a place which he perceived was almost ideal for such an enterprise. A graduate from Rensselaer Polytechnic Institute in 1882, he served an apprenticeship at Lawrence, Mass., under John C. Hoadley, after which he took up railroading in Ohio.

During the Civil War he received a civilian appointment as mechanical engineer in the navy, his work including several naval repair shops on land and also a floating repair shop which was unheard of at that time. Among the jobs handled was the casting and machining of a 500-lb. cylinder head for one of the monitors, a really notable feat for a converted whaling vessel.

Among his other notable work was the building of the Clifton suspension bridge at Niagara Falls, the development of the lead mines at Mine La Motte, Mo., and finally his work with the development of the Solvay process in this country.

Forthcoming Meetings

The fall national convention of the Society of Industrial Engineers will be held at Springfield, Mass., October 5, 6 and 7. The main subject will be "Industrial Stability," covering production, distribution and sales, finance, accounting and personnel.

The Committee on Convention and Exhibits of the American Foundrymen's Association, after carefully considering the question of hotels, exhibits, etc., have decided to hold their next convention in either April or May of next year, 1922. The exact date and the place of meeting will be announced later.

Announcement has just been made that circumstances have necessitated the postponement of the annual convention of the Mechanical Section of the American Railroad Association that was scheduled to be held in Chicago on June 15-16-17 at the Drake Hotel. The new dates that are announced for this convention are June 29 and 30 and it has been transferred to the Hotel Blackstone. Those intending to attend this convention should note not only the change in date but also the change in the location of the convention meetings.

A Branch Cash Register Plant for Germany

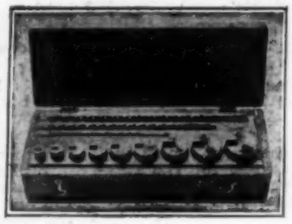
The National Cash Register Co. has a branch plant near Berlin, Germany, which is nearing completion. It is claimed to be a model five-story factory which will employ German workmen under American supervision and it is expected that cash registers will begin to be manufactured within a few months.

There were difficulties in the way of securing raw materials, and also in obtaining permission to bring in sample machines and special tools. Permits were finally granted, however, both in this case and for the Ford Motor plants. The hiring of men is also a problem, as once hired it is very difficult to discharge them owing to the regulations of the Central Employment Agency, which handles all problems of this kind.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Keyway Set, "Broach-Well"
Velco Manufacturing Co., Inc., Greenfield, Mass.
"American Machinist," March 24, 1921.

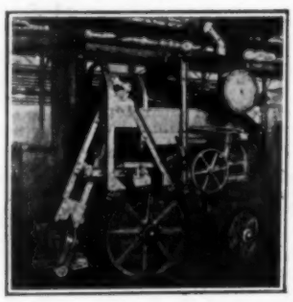


This set of broaches is intended for cutitng keyways in bores, the tools being particularly adapted to shops where the nature of the work does not require a broaching machine. The tools are grouped in convenient sizes, so that a wide range of standard keyways can be cut. By the use of special broaches, keyways of special shape may be cut. A tool-steel broach or cutter bar of the staggered-tooth type is guided in a bushing fitted to the bore in which the keyway is to be made. The keyway is cut by pressing the broach through the work in an arbor press.

Drilling Machine, Three-Spindle
Langelier Manufacturing Co., Arlington, Cranston, R. I.
"American Machinist," March 24, 1921.

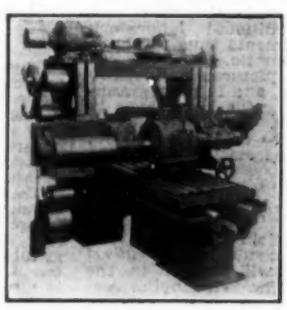
The machine is intended for the drilling simultaneously of three ¼ in. vent holes in the cover of a storage battery. There are two horizontal spindles and one upright spindle, the latter being inclined to the rear at an angle of 8 deg. with the vertical. The drills are held in chucks fastened to the spindles. The two horizontal spindles are driven by separate belts from the overhead countershaft. The vertical spindle is driven in the same manner, the belt passing over the two idler pulleys at the top of the column. The feed of the arms is operated by hand, the movements being so connected that only one lever is necessary to cause the motion of the spindles. The machine is mounted upon a stand, which provides a shelf for the holding of work. The work is secured in position for drilling by means of a special clamping arrangement.

Cutting and Screening Machine, Sand
The Whiting Corporation, Harvey, Ill.
"American Machinist," March 31, 1921.



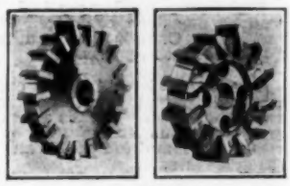
The machine cuts, aerates, screens and tempers molding sand at one operation. It travels across the floor, cutting and screening the sand as it goes, handling, under average conditions, one cubic yard of sand per minute, as shaken from the flask. Rapidly revolving blades cut and aerate the sand and at the same time throw it toward the center of the machine, where it is gathered by the bucket elevator and conveyed to the revolving screen, which removes the refuse. The operation is entirely automatic power being furnished either by electric motor or gasoline engine. Two cutting speeds are available. The steering mechanism will allow of turning in very narrow quarters.

Grinding Machine, Surface, Oscillating
Springfield Manufacturing Co., Bridgeport, Conn.
"American Machinist," March 31, 1921



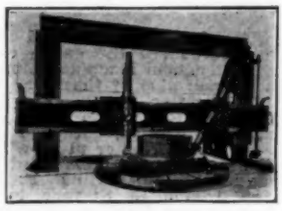
The machine is of heavy construction, carrying two wheels each 20 in. in diameter and 6½ in. wide on a spindle 3½ in. in diameter and mounted in bearings 18 in. long. The spindle is driven direct from the motor, the belt running over a drum pulley connected directly to the spindle. The oscillating motion of the spindle is produced by means of a crank on the right-hand end of the cross rail. The machine shown has capacity to grind 5 ft. long, 30 in. wide and 18 in. high, and it takes 52 in. between the uprights. Weight, 15,645 pounds.

Cutters, Milling, Inserted-Tooth
Cleveland Cutter and Reamer Co., 1619 Merwin Ave., Cleveland, Ohio.
"American Machinist," March 24, 1921.



The cutter at the left is for side milling and the one at the right for face milling. The body of the cutter is made of machine steel, and blades of either carbon or high-speed steel can be furnished. The blades have corrugations on their backs, the corrugations fitting into corresponding grooves in the slots of the cutter body. The blades are clamped in position by means of wedges driven into slits between alternate blades. In order to preserve the diameter of the cutter, the blades can be moved outward as they become worn, the size of the smallest step being the pitch of the grooves. The side milling cutters are made in diameters from 6 to 12 in., being 2 in. in width. The face milling cutters are made in a width of 2½ in. and with diameters from 5½ to 9½ in.

Boring Mill, 16- to 22-ft.
Pulaski Foundry and Manufacturing Corporation, 2422 Euclid Ave., Cleveland, Ohio.
"American Machinist," March 31, 1921.

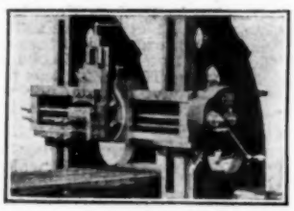


This vertical boring and turning mill is built in four sizes, from 16- to 22-ft. swing. The table is driven through an external gear of large diameter and is supported by a step bearing and an annular bearing running in oil. The table spindle runs in two adjustable bearings of large size. The boring bars are carried by heavy saddles and can be set at angles up to 90 deg. in one direction and 45 deg. in the other The feeds are variable from 0 to ⅜ in. per table revolution. Nine table speeds are available with the constant-speed driving motor. The cross rail is elevated and lowered by a separate motor.

Grinding Machine, Drill
Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass.
"American Machinist," March 31, 1921.

The machine is intended for the sharpening of twist drills from ¼ to ⅝ in. in diameter. The drill is held in a chuck and by the turning of a crank, it is given a combined rotative, eccentric and swinging motion. The two lips are brought consecutively in contact with the grinding wheel. The grinding is said to be always central and true with the axis of the drill. The abrasive wheel is driven directly by means of a small electric motor. The carriage carrying the drill chuck can be moved towards the wheel by means of a hand-lever moving horizontally. The crank at the left is turned by hand, so as to produce the necessary motion of the drill.

Planer, Rapid Power Traverse for
Cincinnati Planer Co., Cincinnati, Ohio.
"American Machinist," March 31, 1921.



The device is intended for rapidly traversing by power the head on the cross-rail of 24 x 24-in. heavy-pattern planers. The device can be put in operation instantly, and when in operation the crank handle does not revolve. It is furnished on planers having either one or two heads; and in the latter case either head can be moved independently, or both heads can be moved simultaneously in either direction. All gearing is completely inclosed.

Clip, paste on 3 x 5-in. cards and file as desired

NEW *and* ENLARGED

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., Bridgeport—The Bradford Mach. Co.—cutter and grinder.

Conn., South Norwalk—The Neptune Hardware Co.—One No. 78 Wilmarth and Norman surface grinder, capacity, 8 x 22 x 11 in. with standard equipment, one No. 2 Reid surface grinder, belt driven, with regular equipment and one 12 in. x 6 ft. Style E Star lathe quick change gear, compound rest and complete standard equipment.

N. Y., Garden City, L. I.—The Adams Trailer Corpn., manufacturer of trailers—one U. S. portable electric grinder complete.

N. Y., Long Island—The City Boro. of Queens, Borough Hall—U. S. bench grinder with 2 wheels, fine and coarse, 12 in. x 1½ in.

N. Y., New York—The Boucher Cork & Mach. Co., 216-222 West 18th St.—one No. 1 Universal Grinder with standard equipment, one No. 2 Greenfield Universal Grinder with standard equipment and one No. 1 Greenfield plain grinder complete with countershaft, one back rest, two 10 x ⅜ in. wheels, etc.

N. Y., New York—The Dye Products and Chemical Co., 200 5th Ave.—one No. 300 A pipe threading machine, belt driven, complete with counter shaft, etc.

N. Y., Rochester — Page & Natapon, 17 South Water St., contractors and builders, N. Natapon, Purch. Agt.—woodworking machinery.

N. Y., Rochester — Page & Natapon, 17 South Water St., contractors and builders, N. Natapon, Purch. Agt. — medium size jointer and 36 in. band saw.

N. J., Jersey City — The Acme Handle Co., 228-232 Orient Ave.—one 9 in. x 4 ft. lathe with complete standard equipment.

Pa., Philadelphia — The Bd. Educ., 198 Chestnut St., M. E. Savage, Supt. of Supplies—lathes and milling machines.

Pa., Philadelphia—The Lester Piano Co., 1306 Chestnut St., A. Lester, pres.—one 30 in. lathe and 1 power pipe threading machine up to 4 in.

Pa., Philadelphia—The W. P. Miller Co., 452 York Ave., manufacturer of paper boxes—one 16 in. power drill press.

Pa., Philadelphia—The G. Sachsenmaier Co., 926 North 3d St., manufacturer of steam machinery—double action drawing Henderson No. 301 press or its equal.

Va., Wytheville—R. P. Johnson, manufacturer of machinery, etc., O. M. Johnson, Purch. Agt.—one 20-24 in. x 6-8 in. double surfacer planer and matcher, to weigh from 3,500 to 5,000 lb., (used).

W. Va., Clarksburg—The Eagle Convex Glass Specialty Co., Box 525, F. Aucremanne, Pres.—beveling machinery and silvering equipment for mirrors and special machine to bevel circles and ovals economically.

N. C., Elkin—The Elkin Furniture Co., R. L. Hubbard, Secy. and Treas.—woodworking equipment, including planers, moulders, shapers, tenoners, sanders, joiners, dove tail achines, rip band, and cut-off saws, glueroom equipment, etc.

Tenn., Chattanooga—M. B. Parker, 1921 Oak St., manufacturer of machinery, etc.—one 36 in. lathe, belted type, to take not less than 16 ft. between centers, (used). One 48 x 48 in. x 16 ft. planer, belted type, with two rail heads.

O., Cincinnati—The Kant-Skore Piston Co., Spring Grove Ave. and Gerrard Sts., J. J. Hater, Treas.—automatic machinery for the manufacture of automobile pistons.

O., Cincinnati—The Kant-Skore Piston Co., Spring Grove Ave. and Garrard Sts., H. J. Hater, Treas.—grinders, lathes, spindle drills and reamers. (See machinery wanted.)

O., Cleveland — The Windau Tool Co., 1565 East 17th St.—small or medium punch press and small or medium hand screw machine, (used).

O., Columbus—The Atlas Chain Hoist Co., 327 West Broad St., manufacturers of chain hoisting equipment, J. H. Burwell, Supt.—one 18 or 20 in. lathe and drill press.

Mich., Detroit — Standard Computing Scale Co., 1118 Library Ave.—band saw and outfit, 30 in. or over, (used).

Wis., Jefferson—F. Schulz, 100 "C" St.—lathe and grinder for use in garage.

Wis., Milwaukee—G. Heise, 883 21st St.—drill press for use in garage.

Kan., Rosedale—Sheldon Tool Co.—stamping presses.

Machinery Wanted

Conn., Middletown — The Forest City Laundry Co., 56-66 Hamlin St.—modern laundry equipment.

Conn., New Britain—J. Niedzwiecki, 215 Farmington Ave. — modern bakery equipment.

Conn., Stamford — Cohn & Abrams, 545 Main St.—equipment for candy plant.

N. Y., Brooklyn—The Brooklyn Eastern Dist. Terminal, 86 Kent Ave., R.R. Terminal—Crescent 38 in. heavy band saw, 38 x 2 in. wheel and 30 x 36 in. table, etc.

N. J., Irvington—The F. C. Messa Co., manufacturer of porcelain supplies — one circular saw machine for 12 in. circular saw, 1 in. arbor, 6 circular saws 12 in. diameter and 15 gage.

N. Y., Rochester—The Alent Mach Tool Co., 479 St. Paul St., machinery manufacturers, N. Alent, Purch. Agt. — cylinder grinding machine, (used).

N. J., Trenton—The Trenton Poster Advertising Co.—electric paste mixing machine for proposed poster factory.

N. C., Henderson—The Carolina Bagging Co., S. S. Parham, vice-pres.—special machinery for the manufacture of horse collar pads, back bands and horse collars of cotton canvas.

Md., Baltimore — The Whiting-Turner Constr. Co., Stewart Bldg.—one pneumatic grouting machine, similar to Caniff, one Erie class B and Marion 61 steam shovel and one steam or belt-driven air compressor, two-stage, 1000 to 1,500 cu.ft. per minute capacity.

Va., Richmond—D. J. Donati, 3210 Williamsburg Ave., manufacturer of fiber boxes—machinery for cutting, forming and making boxes of fiber board.

Ill., Oregon—The Paragon Fdry. Co., J. Reed, pres.—5 ton crane and other equipment for new foundry.

Wis., Fond du Lac — B. F. Sheridan, Route 6—modern creamery and refrigerating machiery.

Wis., Milwaukee — The Alexander Co., 309 East Water St., A. A. Alexander, Purch. Agt.—manufacturer of children's garments-power stitching machines.

Wis., Milwaukee—The Arlington Candy Co., 272 16th St., C. Metrie, Purch. Agt.—candy and confectionery making machinery

Wis., Milwaukee—The Kielsmeier Co., 119 Huron St., R. Kielsmeier—special cheese making machinery, power driven.

Tex., Three Rivers—The Three Rivers Glass Factory, C. R. Tips, pres.—glass making machinery.

Ont., Bowmanville—C. Rehden & Son—electrical equipment for proposed foundry.

Ont., Dresden—The Ontario Beet Growers Assn. Address H. J. French, R.R. 3—machinery for handling beets and making sugar.

Ont., Ottawa—The Ottawa Paper Box Co., Albert St.—machinery to replace that which was recently destroyed by fire.

Ont., Toronto—The Hydro Electric Comn. of Ontario, A. Bock, Chn.—one rotary converter, weight 40 ton for Niagara Falls plant.

Ont., Wallaceburg — W. McLean—necessary machinery for planing mill.

Metal Working Shops

NEW ENGLAND STATES

Mass., Dorchester—P. Bichekas, 1226 Massachusetts Ave., will build a 1 story, 40 x 66 ft. garage on Massachusetts Ave. Estimated cost $12,000. Noted June 2.

Mass., East Long Meadow—Fire recently destroyed the plant of The New England Steel Castings Co., on Shaker Rd. Company is undecided whether to rebuild old plant or erect a new one. Loss, $100,000.

Mass., New Bedford—M. J. Phelan, 116 South St., has awarded the contract for the construction of a 1 story, 80 x 110 ft. garage on Austin St. Estimated cost $20,000.

Mass., West Newton—E. Page, Bigelow Rd., will soon award the contract for the construction of a 1 story garage. Estimated cost $25,000. Ripley & De Boutillier, 45 Bromfield St., Boston, Archts.

THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$25.50
Northern Basic	25.32
Southern Ohio No. 2	27.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	34.26
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75	26.26
Virginia No. 2	*27.00
Basic	†25.00
Grey Forge	*25.00
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern, sil 2.25@2.75	28.67
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	25.46
Basic	23.96
Bessemer	25.96

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Warehouse Jersey City	New York Delivered	Cleveland	Chicago Delivered
Structural shapes	$3.23	$3.33	$3.09	$3.23
Soft steel bars	3.13	3.23	2.99	3.13
Soft steel bar shapes	3.13	3.23	3.48	3.13
Soft steel bands	4.18	4.28	6.25	
Tank plates	3.23	3.33	3.78	3.23

BAR IRON—Prices per 100 lb. at the places named are as follows:

Mill, Pittsburgh	$2.20
Warehouse, New York, delivered	3.13
Warehouse, Cleveland	3.52
Warehouse, Chicago	3.13

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York,	Cleveland	Chicago
No. 10	3.10	4.25	4.00	4.13
No. 12	3.15	4.30	4.05	4.18
No. 14	3.20	4.35	4.10	4.23
No. 16	3.30	4.45	4.20	4.33
Black				
Nos. 17 and 21	3.75	4.80	4.80	5.20
Nos. 22 and 24	3.85	4.85	4.85	5.25
No. 25 and 26	3.90	4.90	4.90	5.30
No. 28	4.00	5.00	5.00	5.40
Galvanized				
No. 10 and 11	4.00	4.75	5.00	5.70
No. 12 to 14	4.10	4.85	5.10	5.80
Nos. 17 and 21	4.40	5.15	5.40	6.10
Nos. 22 and 24	4.55	5.30	5.55	6.25
No. 26	4.70	5.45	5.70	6.30
No. 28	5.00	5.75	6.00	6.40

COLD FINISHED STEEL—Warehouse base prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb.	$4.73	$4.63	$4.25
Flats, squares and hexagons, per 100 lb.	5.23	4.63	4.75

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent
New York	55%
Cleveland	55%
Chicago	50%

Electric Welding Wire—Welding wire in 100-lb. lots sells as follows, f.o.b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/32 to ¼, 7½c. Domestic iron sells at 12c. per lb

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York	Cleveland	Chicago
Openhearth spring steel (heavy)	5.50	8.00	8.25
Spring steel (light)	8.00	7.00	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.20
Hoop steel	3.64	3.69	3.83
Cold rolled strip steel	6.00	8.25	7.90
Floor plates	5.30	3.09@3.40	5.78

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of April 13, 1921:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	62½	50	⅜	33½	18½
			1 to 1¼	35½	20½

LAP WELD

2	54½	41	2	30½	16½
2½ to 6	58½	45	2½ to 4	34½	22½
7 to 12	54½	44	4½ to 6	33½	21½
13 and 14	45	37	7 to 8	24½	12½
15	42½	32	9 to 12	19½	7½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60½	49	1 to 1½	35½	21½
2 to 3	61½	50			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	52½	41	2	31½	18½
2½ to 4	56½	45	2½ to 4	34½	22½
4½ to 6	55½	44	4½ to 6	33½	21½
7 to 8	50½	37	7 to 8	24½	12½
9 to 12	45½	32	9 to 12	19½	7½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20-5% off.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

Copper, electrolytic	14.25
Tin in 5-ton lots	30.25
Lead	5.25
Zinc	5.75
ST. LOUIS	
Lead	4.85
Zinc	5.35

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York	Cleveland	Chicago
Copper sheets, base	21.75	22.50	23.50
Copper wire (carload lots)	16.00	17.50	20.00
Brass sheets	16.25	20.00	20.75
Brass pipe	19.00	22.00	24.50
Solder (half and half) (case lots)	22.00	23.50	17.50

Copper sheets quoted, above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are in cents per pound at warehouse:

New York	14.25
Cleveland	16.00
Chicago	18.75

NICKEL AND MONEL METAL—Base prices in cents per pound, any quantities, f.o.b. Bayonne, N. J.

Nickel	
Ingots and hot	41
Electrolytic	43

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high mangsnese	67

SHOP MATERIALS & SUPPLIES

ZINC SHEETS—The following prices in cents per pound are f. o. b. mill less 8% for carload lots..... 10.00

	Warehouse	
	In Casks	Broken Lots
New York	12.00	12.50
Cleveland	11.15	11.50
Chicago	15.75	16.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

New York	6.00
Chicago	6.00
Cleveland	7.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00	10.00	$10.00
Copper, heavy, and wire	9.00	9.50	9.00
Copper, light, and bottoms	8.00	7.50	8.00
Lead, heavy	3.25	3.50	3.75
Lead, tea	2.00	2.50	2.75
Brass, heavy	6.00	5.50	9.00
Brass, light	4.50	4.00	5.00
No. 1 yellow brass turnings	5.00	4.50	5.00
Zinc	3.00	2.50	3.50

ALUMINUM—The following prices are spot from warehouse, cents per pound:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	28.4	25.50@26.00	30.00

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current
New York (round)	22.75
Chicago	20.50
Cleveland	22.50

BABBITT METAL—Warehouse price in cents per pound:

	New York	Cleveland	Chicago
Best grade	70.00	41.00	35.00
Commercial	30.00	14.75	9.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York, we quote the best two grades, although lower grades may be obtained at much lower prices.

SHOP SUPPLIES

This market is very soft, and our quotations for the present are useful only as a guide.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square	List	$2.25	1.60
Hot pressed hexagon	List	2.25	1.60
Cold punches hexagon	List	2.25	1.60
Cold punched square	List	2.25	1.60

Semi-finished nuts, $\frac{7}{8}$ and smaller, sell at the following discounts from list price:

	Current
New York	60%
Chicago	50%
Cleveland	80%

MACHINE BOLTS—Warehouse, discounts in the following cities:

	New York	Cleveland	Chicago
All sizes up to 1 by 30 in	50-10%	60-10%	50%
1¼ and 1½ in. by 3 in. up to 12 in	50%	50-5%	45%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $2.00 Cleveland..... $4.50 Chicago..... $4.00
For cast-iron washers, ¾ and larger, the base price per 100 lb. is as follows:
New York..... $4.50 Cleveland..... $3.75 Chicago..... $4.00

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
¾ by 6 in. and smaller	40%	60%	40%
Larger and longer up to 1 in. by 30 in	40%	50-10%	40%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets	Burs
Cleveland	40%	10%
Chicago	net	net
New York	40%	25%

RIVETS—The following discounts are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel $\frac{7}{8}$ and smaller	50%	60-10%	45%
Tinned	45%	60-10%	30%

Structural, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York...$4.65 Cleveland...$4.25 Chicago....$4.88 Pittsburgh. $3.70
Boiler, same sizes:
New York...$4.75 Cleveland...$4.35 Chicago....$4.98 Pittsburgh. $3.80

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	21.00	25.00	25.50
Brass	19.00	23.00	24.50

Prices vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities less than 25 lb. add 10c. per lb.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in., inclusive in rounds, and ½-1½ in., inclusive in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $0.75.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $7.70 per 100 lb. In Cleveland—$7.00 per 100 lb.; New York price is $7.50.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	Cleveland	Chicago
White	9.00@12.00	12.00	14.25
Colored mixed	6.50@ 9.50	9.00	12.00

WIPING CLOTHS—Jobbers' price per 1,000 is as follows:

	13½x13½	13½x20½
Cleveland	$55.00	$65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.10
Philadelphia (5 bbl)	1.85
Cleveland	3.25
Chicago	2.50

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.55
Philadelphia (5 bbl.)	2.55
Chicago	4.50

COKE—The following are prices per net ton at ovens, Connellsville:

	Current
Prompt furnace	$3.25@$3.75
Prompt foundry	4.50@ 5.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	100-lb. bag	$0.80
Cleveland	100-lb. bag	0.80

LINSEED OIL—These prices are per gallon:

	Current		
	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.80	$0.88	$0.87
5-gal. cans	.83*	1.03	1.12

*Charge of $2.25 for two cans.

WHITE AND RED LEAD—Base price per pound:

	Current		
	Red		White
	Dry	In Oil	Dry and In Oil
100 lb. keg	13.00	14.50	13.00
25 and 50-lb. kegs	13.25	14.75	13.00
12½-lb. keg	13.50	15.00	13.50
5-lb. cans	16.00	17.50	16.00
1-lb. cans	18.00	19.50	18.00

500-lb. lots less 10% discount; 2,000-lb. lots less 10-4% discount; 10,000 lb. lots less 10-7½% discount. Business is good in white lead.

Conn., Ansonia—The Ansonia Electric Co., 55 Main St., will soon award the contract for the construction of a 2 story, 60 x 200 ft. plant. Estimated cost $250,000. Fletcher-Thompson, Inc., 542 Fairfield Ave., Bridgeport, Engrs. and Archts. Noted June 9.

Conn., Hartford—J. B. Kaufman, 432 Windsor Ave., will soon award the contract for the construction of a 1 story, 50 x 110 ft. garage on Windsor Ave. Estimated cost $25,000. B. A. Sellew, 721 Main St., Archt.

Conn., Hartford—The Prospect Garage, 585 Prospect Ave., is receiving bids for the construction of a 1 story addition to its garage on Prospect Ave. Estimated cost $20,000. B. H. Sellew, 721 Main St., Archt.

Conn., New Britain—The Mendel Sicklick, 107 Bossett St., has awarded the contract for the construction of a 1 story, 60 x 70 ft garage on Arch St. Estimated cost $10,000. F. C. Walz, 407 Trumbull St., Hartford, Archt.

Conn., New Haven—F. T. Hershkowitz, 401 George St., will build a 1 and 2 story, 44 x 160 ft. garage, etc., on George St. Estimated cost $25,000.

Conn., Waterbury—The Dexter Baking Co., North Main St., is having plans prepared for the construction of a 1 story, 60 x 100 ft. garage. Estimated cost $20,000. J. S. Ladow, 51 Leavenworth St., Archt.

Conn., Windsor—S. Maislen, 356 Windsor Ave., is having plans prepared for the construction of a 1 story, 50 x 80 ft. garage on High St. Estimated cost $15,000. Dunkelberger & Gilman, 721 Main St., Archts.

R. I., Pawtucket—W. R. Nichols, 161 Hunt Ave., will build a 1 story, 50 x 104 ft. garage on Arthur and Brooks Sts. Estimated cost $15,000.

Vt., Rutland—W. H. Williams has awarded the contract for the construction of a 67 x 128 ft. garage, etc., on West St. Estimated cost $42,000.

MIDDLE ATLANTIC STATES

N. Y., New York—J. Reinschmidt, c/o Dunnigan & Crumley, Engrs. and Archts., 394 East 150th St., will soon receive bids for the construction of a 1 story, 125 x 140 ft. garage on Jerome Ave., near Belmont St., Bronx. Estimated cost $50,000.

N. J., Trenton—J. A. Roeblings Sons Co., 612 South Broad St., wire rope manufacturers, will build a 2 story, 500 x 850 ft. addition to its plant on Lalor St. Estimated cost $150,000.

Pa., Pittsburgh—W. W. Martin Co., 5847 Center Ave., will soon award the contract for the construction of a 3 story, 100 x 140 ft. auto sales and service building on Ravenna St. and South Highland Ave. Estimated cost $150,000. Private plans.

Pa., Turtle Creek—Struble & Riley will soon award the contract for the construction of a 2 story, 74 x 165 ft. sales and service building on Grant St. Estimated cost $100,000. S. C. Richards & Co., Braddock, Archts.

Md., Frederick—The Star Motor Co. is building a 1 story, 50 x 60 ft., machine shop.

SOUTHERN STATES

Va., Bristol—The Bristol Stove & Fdry. Co. is enlarging its plant. J. C. Rucker, Secy. and Treas.

Ala., Birmingham—The Atlas Mch. & Supply Co., 1 South 20th St., is building a 66 x 101 ft., machine shop. Estimated cost $10,000.

MIDDLE WEST STATES

O., Cleveland—M. Freedman, 4715 Woodland Ave., has awarded the contract for the construction of a 1 story, 82 x 105 ft. garage at 8400 St. Clair Ave. Estimated cost $80,000.

O., Cleveland—E. Friedman, 980 East 70th St., will soon award the contract for the construction of a 1 story, 66 x 140 ft. garage and commercial building at 6937 St. Clair Ave. Estimated cost $40,000.

O., Cleveland—The New Center Garage Co., c/o H. E. Emerich, 15205 St. Clair Ave., will soon award the contract for the construction of a 2 story, 55 x 150 ft. garage and commercial building on Holmes and St. Clair Aves. Estimated cost $60,000. H. W. Steffens, 13000 Forest Hill Ave., Archt.

O., Cleveland—The Sterling Brass Co., 4610 St. Clair Ave., will soon award the contract for the construction of a 2 story, 75 x 90 ft. foundry and machine shop, on East 93rd St. and Catherine Ave. Estimated cost $80,000. A. Sogg, 319 Hippodrome Bldg., Archt. Noted Apr. 21.

O., Cleveland—P. M. Platten, 348 Engineers Bldg., has awarded the contract for the construction of a 1 story, 45 x 137 ft. commercial and garage building on East 133rd St. and Niles Ave. Estimated cost, $40,000.

Ind., Richmond—The Grim Auto Co., 7th and Sailor Sts., plans to build a 2 story, 71 x 104 ft. garage and service building on 7th St. Estimated cost, $75,000. C. E. Werking & Son, Palladium Bldg., Archts.

Ind., Terre Haute—The Terre Haute Boiler Wks., 1225 7th Ave., plans to build a 1 story, boiler factory on North 13th St. Estimated cost $75,000. Private plans.

Ill., Aurora—The Miller-Bryan & Pierce Co., 225 River St., manufacturer of typewriter supplies, has awarded the contract for the construction of a 3 story, 60 x 150 ft., factory. Estimated cost $60,000.

Wis., Park Falls—Greissinger Bros. have awarded the contract for the construction of a 1 and 2 story, 50 x 68 ft. garage and repair shop. Estimated cost $45,000.

Ill., Oregon—The Paragon Fdry. Co. is having plans prepared for the construction of a 1 story, 100 x 200 ft. foundry. Estimated cost $50,000. J. Reed, pres. N. E. Buser, Mt. Morris, Archt.

Minn., Minneapolis—The Kremer Motor Co., 1518 Hennepin Ave., will soon award the contract for the construction of a 2 story, 50 x 150 ft. garage at 1411 Yale Pl. Estimated cost $70,000. P. E. Crosier, 916 New York Life Bldg., Archt. Noted May 5.

Okla., Sapulpa—The Sapulpa Motor Co., Main and Hobson St., is having plans prepared for the construction of a 1 story, 140 x 140 ft. garage. Estimated cost $80,000. Monnett & Reid, 409 Empire Bldg., Oklahoma City, Archts.

Tex., Dallas—The Flippen Auto Co., 2021 Cedar Springs St., will soon award the contract for the construction of a 2 story, 100 x 200 ft., garage on Ross Ave. Estimated cost $125,000. Barclebaugh & Whitman, South West Life Bldg., Archts.

CANADA

Ont., Bowmanville—C. Rehden & Son have awarded the contract for the construction of a 1 story foundry on Scogog St. Estimated cost $60,000. Noted Apr. 28.

Ont., Toronto—C. A. Ward, 26 Oxford St., plans to build a 1 or 2 story, garage on Oxford St. Estimated cost $35,000. Architect not selected.

General Manufacturing

NEW ENGLAND STATES

Me., Dexter—D. Whiting & Sons, Charlestown, Mass., are having plans prepared rebuilding creamery, on Grove St., which was recently destroyed by fire. Estimated cost $25,000. Haven & Crosby, 40 Court St., Boston, Mass., Engrs. and Archts.

Conn., Hartford—The Graphic Arts Co., 74 Union Pl., is having plans prepared for the construction of a 3 story, 50 x 150 ft. plant for getting out advertising material, etc., on High St. Estimated cost $80,000. Buck & Sheldon, Inc., 60 Prospect St., Archts. and Engrs.

Conn., Meriden—C. E. Schunack, 24 Randolph Ave., has awarded the contract for the construction of a 2 story, 40 x 50 ft. and 14 x 42 ft. additions to his box factory. Estimated cost $18,000. Private plans.

Conn., Middletown—The Forest City Laundry Co., 56-66 Hamlin St., will soon award the contract for the construction of a 1 story, 50 x 100 ft. laundry on William St. Estimated cost $20,000. W. D. Johnson & Co., 174 Bond St., Hartford, Archts. Noted May 5.

Conn., New Britain—The Niedzwiecki Bakery, 215 Farmington Ave., will soon award the contract for the construction of a 2 story, 45 x 65 ft. bakery on Farmington Ave. Estimated cost $30,000. H. A. Ludorf, Mutual Bldg., Archt. Noted April 7.

Conn., Stamford—Cohn & Abrams, 545 Main St., are having revised plans prepared for the construction of a 3 story, 40 x 85 ft. candy factory on Beckley Ave. Estimated cost $40,000. W. R. Steinmetz, 441 Atlantic Ave., Archt. Noted Apr. 7.

MIDDLE ATLANTIC STATES

N. Y., Brooklyn—The Erie Dyeing and Processing Co., 2765 East 55th St., Cleveland, O., will soon award the contract for the construction of a 1 story wool dyeing plant, on Nassau Ave. near East 14th St., here. Estimated cost $125,000. S. H. White, 1032 Schofield Bldg., Cleveland, O., Archt.

N. Y., Buffalo—J. Christensen, 633-639 Genesee St., has had plans prepared for the construction of a 1 and 2 story factory for the manufacture of wagons, auto bodies, etc. Estimated cost, $12,000. J. A. Brown, 778 Genesee St., Archt.

N. Y., Mt. Vernon—The Willow Brook Dairy Co. will receive bids about July 7, for the construction of a 1 and 2 story dairy, to include a garage and power plant. Estimated cost $250,000. McCormach Co., Century Bldg., Pittsburgh, Pa., Engrs. and Archts. Noted Mar. 31.

N. J., Trenton—The Trenton Poster Advertising Co. will build a 4 story, 100 x 150 ft. factory on East State St. Estimated cost $100,000. Noted Mar. 31.

SOUTHERN STATES

Va., Richmond—D. F. Donati, 3210 Williamsburg Ave., manufacturers of fibre boxes, has awarded the contract for the construction of a 50 x 50 ft. factory. Estimated cost $8,000.

N. C., Elkin—The Elkin Furniture Co. plans to rebuild shop recently destroyed by fire. R. L. Hubbard, Secy. and Treas.

MIDDLE WEST STATES

O., Cincinnati—The Hyde Park Dairy Co., 3755 Edwards St., is having preliminary plans prepared for the construction of a 2 story, 32 x 86 ft. dairy. Estimated cost $45,000. H. W. Voelz, 86 Michigan St., Milwaukee, Wis., Archt.

O., Cleveland—The Prinz-Biederman Co., West 6th St. and Lakeside Ave., manufacturer of clothing, plans to build a 3 story factory on McCrocken Rd. Estimated cost $250,000. W. B. Fish, Treas. Architect not selected.

Ind., Indianapolis—Best-Grand Laundry, North Capitol Ave., has awarded the contract for the construction of a 2 and 3 story, 67 x 200 ft. laundry on North Capitol Ave. Estimated cost $100,000.

Wis., Milwaukee—The Atlas Bread Co. is altering and making a 2 story addition to its bakery. Estimated cost $150,000. McCormack Co., Century Bldg., Pittsburgh, Pa., Engrs. and Archts.

Wis., Racine—The Fox Ice Co., Liberty St. will build a 1 story, 124 x 198 ft. artificial ice plant. Estimated cost $50,000.

WEST OF THE MISSISSIPPI

Mo., Webb City—E. Webb, Bway. and Webb Sts., plans to build a 2 story flour mill. Estimated cost $30,000. Architect not selected.

Minn., Paynesville—Farmers Co., c/o J. A. Jerabek, Secy. Treas., plans to build flour mill. Estimated cost $50,000. Architect not announced.

Tex., Kerrville—Amer. Legion Memorial of Texas, Austin, will open bids about Aug. 15, constructing twenty to twenty-five 1 and 2 story buildings, here, to form tubercular sanitorium. Plans include complete refrigerating and ice plant. Estimated cost $1,500,000. Phelps & Dewes, 715 Gunter Bldg., San Antonio, Tex., Archts.

CANADA

Ont., Dresden—The Ontario Beet Growers Assn. plans to build a beet sugar factory. Estimated cost $100,000. Address H. J. French, R. R. 3.

Ont., Windsor—Seguin Bros., 906 Parent Ave., will soon award the contract for the construction of a 1 and 2 story, 36 x 143 ft. printing plant on Wyandotte St. Estimated cost $40,000. G. J. P. Joques, 4 Sandwich St., W., Archt.

Que., Joliette—Joliette Cigar & Tobacco Co., St. Marc St., is having plans prepared for the construction of a 3 story, 150 x 200 ft., tobacco factory. Estimated cost $150,000. G. H. Rivest, Joliette, Arct.